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THE STANDARD CYCLOPEDIA
OF MODERN AGRICULTURE
AND RURAL ECONOMY

THE
STANDARD CYCLOPEDIA OF
AND RURAL ECONOMY

BY THE MOST DISTINGUISHED
AUTHORITIES AND SPECIALISTS
UNDER THE EDITORSHIP OF

F H A S F R S E PRINCIPAL OF THE WEST OF SCOTLAND
AGRICULTURAL COLLEGE GLASGOW

VOLUME II
AUS BRO

34 AND 35 SOUTHAMPTON STREET STRAND LONDON

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In like manner the great botanical articles of the late Professor John Lindley, which, like Curtis's articles above mentioned, were contributed to Morton's *Cyclopedia of Agriculture*, have, under Professor A. N. M'Alpine's revision, been embodied over the initials J. L. and A. N. M'A.

THE STANDARD CYCLOPEDIA OF MODERN AGRICULTURE

Australia, Agriculture of.—The principal factors in the agricultural development of Australia have been stock husbandry and the growing of cereals. Mixed farming, wine and fruit growing, and sugar culture are also carried on most successfully, the Australian continent being of such extent as to provide almost every choice in respect to soils and climate. The pioneer settlers devoted themselves, naturally enough, to pastoral pursuits, with a sufficiency of agriculture to provide for the bulk of their immediate necessities, but oddly the real progress of Australia in these directions dates to the mining period, from 1851 onwards, many people among the new element having abandoned mining as soon as the initial excitement had subsided and they had recognized the exceptional opportunities that grazing and cultivation afforded. Of late years the continual improvements in connection with shipping, and more especially those admitting the carriage of perishable products over long distances, have opened up a wide avenue into which Australian agriculturists and pastoralists have not been loath to push their way.

The wealthy descendants of the earlier settlers preserve the traditions of Australia as a pastoral country first and foremost, and they do so by assiduous regard to the breeding of their flocks and herds, ensuring the vigour of their stock by the frequent selection of sires and dams from the finest studs of other countries. On the other hand, the development of a great oversea trade has provided an opportunity for farming on smaller and more intense lines. The Governments of the six States comprised within the Commonwealth have retained control of lands administration, and they are all committed to a policy of closer settlement under which many of the large holdings of land established by the pioneer pastoralists are being repurchased and subdivided. In some cases this example is being followed voluntarily by the owners themselves. There are still, however, many millions of acres in the interior parts of Australia which, with irrigation and the extension of railway and other facilities, will lend themselves to development. The significance of this statement may be realized when it is explained that whilst the Australian Commonwealth contains some 2,972,906 sq. miles, the total population scarcely exceeds 4,000,000, and the total area under cultivation for crops is under 13,000,000 acres. Large tracts, however, must always remain as arid deserts

CLIMATE.—About a third part of Australia lies within the torrid zone, and the climate varies from tropical and sub-tropical to conditions as temperate as those of France. From the great extent of the Australian continent, when a portion is affected by adverse conditions, the unaffected portions may be reaping an advantage. The seasons are the exact reverse of those in Europe, and the advantage that this has given, in ensuring for Australian farmers an outside market during seasons of scarce supply elsewhere, has outweighed the drawback of great distance.

A total of 45 per cent of the land in the Australian Commonwealth is within the area of 15 in annual rainfall. Round the eastern and northern coastal districts the mean average rainfall ranges from 35 to 70 in Portions of Australia are subject to extended periods of drought, western New South Wales and Queensland having the greatest liability among settled territories to suffer in this way. Large rivers pass through these areas, but they are fed chiefly by torrential rains, and are subject to great evaporation, and also to soakage, so that their supply of water to the surrounding thousands of square miles of absolutely flat country is impermanent. In times of severe drought, in fact, these watercourses become completely dry with the exception of occasional pools. In some instances the rivers are navigable for commercial purposes along hundreds of miles during the winter months, but are so depleted by the causes stated, that in the summer period it becomes quite impossible to use them for traffic A few scattered lakes exist in the dry regions, but they are governed by the same unreliability.

Australia, however, possesses a remarkable power of recovery from even the worst droughts. During the years from 1896 to 1902, probably the most disastrous series of droughts in the history of the continent was experienced. The whole of the pastoral districts of New South Wales and Queensland were affected in greater or less degree. The northern parts of Victoria and a portion of South Australia also suffered. In the stricken areas literally not a blade of grass could be seen for hundreds of miles at a stretch. Sheep, cattle, and horses had to be abandoned to starvation in millions, and the pastoralists were in despair. This severe drought broke at the end of 1902, and within two years the majority of the great pastoral estates had recovered their normal prosperity. These conditions of occasional drought, which have been affirmed by no less an authority than the late Mr. H. C. Russell, Government Astronomer and Meteorologist of New South Wales, to arrive in cycles, are frequently alluded to outside Australia as though they affect the whole continent, but in reality they touch only certain zones. Their effects would be greatly minimized were it not for a degree of recklessness which is characteristic of Australian pastoralists, who, as pointed out by Mr. W. T. Wright, a leading authority, in The Live Stock Annual of Australia, themselves 'contribute to the difficulties of the situation by overstocking, and relying too much on the bountiful character of the country'.

New South Wales provides every phase of climate within the designation of 'temperate', the Blue Mountain range, part of the Great Dividing Range, which cuts off the coastal districts from the interior, being to a great extent responsible for the variety. Only upon these mountains and the adjacent high levels is snow encountered. The range lies from 40 to 70 miles back from the coast line, and the area between the mountains and the sea is subject to a good rainfall, and is well watered and very fecund. In these districts the rainfall is from 40 to 70 in. annually. The land is chiefly employed for dairy farming. The temperature recorded in Sydney may be regarded as the standard for this portion of New South Wales, the mean being 63°. There is little variation between the summer and winter temperatures, 70° being about the mean registration for summer, with occasional extremely hot spells, rising to over 100°, and 56° being the mean registration for winter months. On the tablelands situate on the interior of the mountains, climatic variations are greater. The average heat closely approximates to that of the Sydney district in summer, and the winter temperatures show a mean of about 46°. These tablelands are devoted to mixed farming. The western portion of New South Wales, from a line about 300 miles inland, suffers from the inadequacy of its rainfall. The average annual fall over some 100,000,000 ac. of this division of Australia is 24 in., but in the extreme west of the State it diminishes to about 10 in. The western area, which is devoted almost entirely to sheep-farming, is within the drought zone. In the extreme north of New South Wales, which is watered by numerous large rivers, the rainfall averages as much as 74 in. in the Tweed River district. In Sydney the average is 50 in., and on the coast to the extreme south of Sydney the annual fall amounts to 36 in.

The climate of Victoria is milder than that of New South Wales. The annual mean temperature in the central district, that surrounding Melbourne, the capital, is about 57°. The average rainfall hereabouts is about 26 in. In the western division of the State the rainfall is about the same. The Gippsland area, lying to the south-east of Melbourne, is one of the most fertile portions of Australia, and is aided by a rainfall averaging from 32 to 40 in. In the north-eastern division the fall varies from 26 to 35 in. The most arid country is found in the neighbourhood of the South Australian border and in the Mallee scrublands, which have been converted, in spite of great difficulties, into a splendid agricultural asset. In the Mallee country the average rainfall is only 10 to 14 in., and in the contiguous Wimmera district the fall reaches only 17 or 18 in. per annum. Frosts are encountered during two or three months of the year over the major portion of Victoria, but they rarely exceed some 4°.

In Queensland, which extends over 18° of latitude, the temperatures rise to tropical limits in the north, while the south and central portions are in the equable zone. The variations of rainfall in the north are very remarkable. While at Brisbane, which is situate on the coast in the southern portion of the State, the annual average is 58 in., the fall in the vicinity of Cooktown, 500 miles north of the tropic of Capricorn, sometimes exceeds 160 in. for the year.

South Australia and Western Australia both share practically the whole of the climatic conditions to be found in the other portions of the Australian mainland. In South Australia the average mean temperature in the winter months is about 52°, and in the summer months about 72° or 73°. The Northern Territory, which is now being handed over by South Australia to the Commonwealth Government for pastoral and agricultural development, is tropical except on the southern tablelands. In the extreme north the average rainfall is 63 in., but farther south it is much less.

In Western Australia, which comprises fully one-third of the whole continent, the mean average temperature for the south-west is officially stated at 70 to 75° for the months from December to March, and 51 to 58° in the winter period from June to August. The mean yearly average is set down as 61°. Differences of latitude, elevation, &c., bring about great variations in the rainfall, which averages in the settled south-west division 23 in., but is considerably less in the general area.

Of all the Australian group, the island State of Tasmania approximates most closely to Great Britain in the matter of climate. At Hobart, in the south of the island, the mean maximum temperature is about 62°, and the mean minimum about 45°. At Launceston, in the north, the average readings closely approximate to these. The rainfall is very regular in its distribution, the general average for the bulk of the State being from about 20 to 40 in. annually. On the mountainous western and south-western coasts, however, very heavy falls are the rule, and in some places over 100 in. annually are recorded.

Soils.—Data relating to the soils of Australia have as yet been prepared in a very crude and unserviceable form. In such cases as those of Western Australia and the Northern Territory of South Australia, it can readily be understood that insufficient is known respecting large tracts to make the data in any way complete, but even in New South Wales satisfactory descriptions of the soils have not yet been presented. In the parent State, the district surrounding Sydney, the capital, is the most forbidding in the matter of soils, the formation being mainly sandstone, with a shallow loam in places. The richest soils are found in the neighbourhood of the farther northern rivers, being generally of volcanic origin, and possessing three times the fertility of those in the metropolitan area. The valley of the Hunter River, which is the scene, near its mouth, of great coal-mining operations, has deep alluvial flats. In the Illawarra coastal district, to the south of Sydney, rich basaltic hills slope down to the sea. South of the Shoalhaven River poor sandstone country is met with. Going inland to the southern borders of New South Wales, the immense stretch of flat land consists of rich red loam, and the same class of soil is found over the whole western portion of the State. In the northern inland parts, plains of stiff black soil are found

About one-third of Victoria consists of mountain ranges and elevated plains to the east and north-east of Melbourne, and these over a large area have been covered by volcanic action The northern plain of this State furnishes rich black alluvial soil, and the western district contains extremely fertile volcanic loam over the bulk of some 6,000,000 ac The soils of the coastal plain differ greatly in average composition Light sands and sandy loams are found to the south-east of Melbourne, and also near Geelong. The river flats of Gippsland are extremely rich, and there is also some very rich limestone country in this area

Queensland has many of the soil characteristics to be found in New South Wales Volcanic areas of some richness are in existence there, but the lower lands are poor, with the exception of the river valleys, which fortunately are both numerous and wide A strip of blacksoil country is met with in the south. The Darling Downs, which are in area about half the size of the whole State of Victoria, contain the finest agricultural soils to be found in Queensland To the west of the Dividing Range, fertile plains of red loam are the distinguishing characteristic.

The richest soils of South Australia are met with in the valleys and slopes of the Flinders Range, in an area some 500 miles in extent. They are generally of light loamy composition. On the western side of Spencer's Gulf many isolated granite hills are found in sandy desert surroundings, with here and there clay flats In respect of central Australia and the Northern Territory little is recorded about the details of soils, but with the exception of a large strip of sandy desert the general character of the land resembles in some degree that of western New South Wales and Queensland

The elevation of the western section of Australia being very slight, the drainage towards the central depression is reduced to a minimum. Rainwaters collect in marshes in the centre of Western Australia, and these for the most part are salt. The soils of the far interior consist generally of disintegrated granite rocks, and are sterile and dry. The great south-western section of Western Australia, however, with the York district as its centre, contains soils of volcanic origin, suitable for all classes of cultivation.

Tasmania possesses a large proportion of rich soils of a volcanic character, and all over the midland and north-western and northern portions of the island excellent brown loams are found.

The Pastoral Industry.—The value of Australia as a sheep-raising continent was recognized from the very beginnings of its history as a white settlement. Knowledge of the great coastal areas of New South Wales soon extended to the south and the interior, and it was speedily understood that in the undulating plains west of the Blue Mountains nature had provided an ideal country for the depasturing of sheep and cattle. Finally came the knowledge that beyond lay many millions of acres suitable for sheep-farming on a mammoth scale. The opening up of the regions now known as Victoria, South Australia, and Queensland revealed similar almost boundless resources, and finally Western Australia is now coming into prominence as a sheep-raising country.

Sheep-farming in Australia differs so completely from ordinary standards that it is difficult for even the biggest European farmers to understand Sheep runs are in many cases from 100,000 to 150,000 acres in extent, and there are 'squatters' in Australia who number their sheep by hundreds of thousands. The 'paddocks' in which these sheep are allowed to roam are on an immense scale, 4000 or 5000 acres being comprised in a single paddock. The warmth of the Australian climate renders it unnecessary to house or to hand-feed sheep even in the depth of winter, and those tasks would be quite impossible of accomplishment where such great flocks are concerned. Only at the 'rounding-up' of the sheep at shearing time can the big pastoralists form anything like an idea of the numbers of sheep in their possession at a given period The significance of the sheep-growing industry as a factor in Australian prosperity may be judged from the fact that exports of wool and of frozen mutton amount to about one-fourth of the total for all products In 1906 there were in Australia 74.403,704 sheep, valued at £54,268,195. The wool produced in 1906 represented a money value of £22,645,000 During one hundred years the value of the product has been £647,000,000.

In the early days of sheep-farming in Australia, merinos were for the most part selected as the most suitable flocks. Systematic attention was given to breeding, with the result that the flocks not only multiplied at a great rate, but improved as well So much skill was shown in the evolution of the merino that it has become almost impossible to recognize the original short-woolled sheep in the massive and heavily fleeced animal of the present day. The wool produced from these sheep has density, length of staple, and lustre, which have placed the Australian product in the foremost position in the world's markets. Not only does the Australian breed of merino differ in almost every essential from the merino to be seen elsewhere, but a great difference exists between the types as found in various parts of the continent.

Thus in New South Wales pastoralists have succeeded in producing a sheep of moderate size, which is, however, covered with enormous folds upon the neck, body, and quarters, between which innumerable wrinkles are to be found. All this extra skin provides a surface for wool so densely packed that even when it is parted by the fingers it is impossible to see the pink surface of the animal's skin. Even the eyes of stud merinoes are frequently overgrown by the wool, which has to be clipped to enable the animals to see. Some discussion has arisen as to whether this development of the merino is not being carried too far. See art MERINO.

The South Australian type of sheep is not quite so densely fleeced as those of New South Wales, one representative ram from which division cut 50 lb. of greasy wool at one shearing, the product being worth 9*d.* per lb. Of the British breeds of sheep, Shropshires and Border Leicesters are in great favour in the parent State. Lincolns are used largely in the breeding of crossbreds, the resulting wool being of valuable quality and the fleeces large The value of the New South Wales clip in 1906 was £14,186,562, the average realized per fleece being from 6*s.* 6*d* to 7*s.* 6*d* The number of sheep depastured in that State was approximately 44,000,000. The average allowance for consumption and export in the three years preceding 1905 was 5,000,000, and notwithstanding this, the numbers, which had been decimated greatly through long-continued drought, had in the three years increased by one-third. The number of ewes marked for lambing in 1905 was 15,281,000, so that when 5,000,000 sheep were allowed for export and home consumption, the estimate was officially made that New South Wales would carry 50,000,000 sheep, worth 10*s.* a head

Victoria has an area that lends itself more largely to intense culture than does New South Wales, but sheep-farming is an ever-developing pursuit. The number of sheep in Victoria at the end of 1906 was 12,937,440, the increase during the year amounting to 1,500,000 The greater portion of the pasturage consists of native grasses and forms of herbage, which are highly nutritious. Many large pastoral estates are devoted in the main to wool-growing. This is particularly the case in the western, north-western, and north-eastern portions of the State. In addition to the pure merinoes, which have placed Victorian wool at the head of the market, judicious crosses have been made of Lincoln and Leicester rams with large-framed merino ewes, resulting in a large output of crossbred wools of a heavy character and glossy staple. The weight of wool per sheep has been steadily raised by close attention to breeding. In 1906 the average weight was 6·34 lb. per fleece, as compared with 4·52 lb. per fleece in 1861. The quantity of wool produced in Victoria in 1906 was 75,738,303 lb., of a value of £3,313,550. Much attention has been devoted by the Victorian farmers to the breeding of crossbred lambs for the London market. Shropshires, Southdowns, Lincolns, and Border Leicesters are chiefly favoured for crossing with merino or crossbred ewes for this purpose, lambs being produced which weigh from 36 to 40 lb. when killed and dressed at four or five months In 1906 the total number of frozen lambs and sheep exported from Victoria was 717,000, valued at £466,000.

The magnificent Darling Downs are the most favoured part of Queensland for sheep-raising, but there are fine tracts of pasturage stretching northward as far as the Burdekin River, and in the districts to the westward drained by the Maranoa and Thomson Rivers. The Queensland flocks, which numbered at one time nearly 22,000,000, were greatly reduced by the drought that ended in 1902, and in that year the returns showed that only 7,214,000 sheep remained. The upbuilding of flocks in the four succeeding years was extraordinary, and at the close of 1906 it was estimated that there were 14,886,000 sheep in Queensland The value of the wool produced in that year was £3,388,929. As in the other States, the greater number of sheep in Queensland are merinoes, the proportion as compared with other breeds being about 96 per cent.

The flocks in South Australia at the end of 1906 numbered 6,624,911, and the value of the year's wool production was officially set down at £1,300,600 Since the foundation of South Australia some three-quarters of a century ago, wool to the value of over £64,000,000 has been exported The yield of wool per head of sheep has increased from 4·69 lb. in 1860 to 8 lb. per head at the present time In 1906 over 200,000 carcasses of mutton and lamb were shipped from South Australia to the London market

Western Australia possesses vast tracts of pastoral land, as yet only meagrely settled At the end of 1906 the sheep flocks numbered 3,333,000. The export of wool was correspondingly moderate in amount, its value being computed at £603,000 The 'runs' in the northern portions of Western Australia are as yet only sparsely stocked in consequence of the inadequacy of the water supplies, but artesian boring is being conducted both by Government and private enterprise, with the result that a great increase in the number of sheep has taken place during the past three or four years The native grasses are highly nutritious, and good grazing is found in the regions where cotton-bush and salt-bush are the staple growths. Western Australia possesses the advantage that, for the time being, invasion by the rabbit pest has been averted

In Tasmania the pastoralists do not follow up sheep-growing on as immense a scale as in the larger States of the mainland, but the island State has a reputation for the breeding of pedigree animals for the improvement of Australian flocks generally. So desirable are some of the stud animals raised in Tasmania that as much as £1600 has been paid for one ram. The Tasmanian wool clip in 1906 was valued at over £400,000

The Australian sheep-farmers have at times had difficulties of a most serious nature to contend with. As already shown under the heading of 'Climate', portions of the continent, and particularly the far western districts of New South Wales and Queensland, are subject to periods of prolonged drought, and there is no easy or economical means of providing against such adverse conditions, as by storing reserves of fodder, for instance, though some practical system of this kind may yet be introduced. Under these circumstances, drought means the wholesale destruction of the flocks. Australia is a land of such quick recoveries, however, that even the lessons of a drought as severe as that of 1902 and the five years preceding, are in danger of being soon forgotten in the tide of prosperity.

Cattle and Dairying.—The raising of cattle is also a most thriving industry in Australia. Little more than a century has passed since the modest beginnings of the present mammoth herds were made, the first governor of the Botany Bay convict settlement landing an initial consignment of stock which included 1 bull, 4 cows, and 1 calf. At the beginning of 1906 there were in the whole of Australia 8,178,000 head of cattle, the value of which was computed at £34,585,000. The eastern States have been quick during recent years to benefit by the development of the frozen-meat trade. Millions of acres in Western Australia, the Northern Territory, and other parts are still waiting to be utilized in the spread of the cattle trade. The extensive runs in Queensland accommodate the largest herds, whilst Victoria and the New South Wales river and coastal districts adapt themselves more particularly to dairying. The breeding studs in these parts of Australia are well established, every care having been taken in that respect from the inception of the cattle-raising industry, when pure Shorthorns and Ayrshires, Herefords, Jerseys, and other animals selected from the foremost studs of Great Britain were introduced All the Australian herds are of English and Scottish origin, and breeders maintain their vigour by the further importation of pedigree animals

Shorthorn cattle have been the foundational element in the establishment of most of the Australian dairy herds-- Shorthorns having greatly predominated before dairying showed any signs of expanding into the profitable industry it has now become Jerseys and Ayrshires were imported and crossed with the Shorthorns, and in recent years Holsteins have come into favour as milk producers The Dutch cattle are now being interbred with Jerseys and Ayrshires, a fine milking type being the result. There is a disposition among some of the farmers, especially in the southern dairying districts of New South Wales, to revert to the Shorthorn strain for breeding purposes

The Queensland product, with its massive frame, may be regarded as typical of Australian beef stock. Cattle have in Queensland frequently to be travelled long distances in search of good pasturage, but this 'overlanding' is done on a large scale It was computed in 1906 that there were about 3,600,000 head of cattle in Queensland, principally Shorthorns and Herefords. In New South Wales it was estimated at the end of the same year that there were 1,694,000 head of cattle for beef purposes, while the dairy herds totalled 644,000 head. Shorthorns are greatly in favour in this State, the milking strains having been found as suitable as the beef types. Herefords and all the other leading British breeds are to be found in large numbers in New South Wales, the Ayrshires having foremost place among dairy cattle. In Victoria the raising of cattle is not so much confined to the big pastoral estates as in Queensland and some parts of New South Wales. The rich and well-watered grazing areas of this division are the most suitable for cattle fattening, but advantage has been taken of the opportunities for mixed farming, and the raising of cattle, instead of being an avocation apart, is more generally combined with wheat-growing and other forms of agriculture. Portions of the verdant western district and of the Gippsland hillsides are devoted almost exclusively to dairying. In 1906 it was estimated by the Victorian Agricultural Department that there were 649,100 dairy cows in that State, the other herds numbering 1,088,590.

The three other divisions of South Australia, Western Australia, and Tasmania do not up to the present enter so seriously into calculation as cattle producers The first-mentioned State possessed a total of 300,000 cattle in 1906, whilst Tasmania and Western Australia contained still smaller numbers In all cases, however, breeding is carried out on a system which ensures reliable types of stock

Dairy farming has shown a great increase during recent years, the use of refrigerating machinery having placed Australian dairy products on the English and other distant markets. The introduction of the cream separator and the factory system of butter manufacture have enabled farmers to enter into this competition with co-operative spirit, and Australia has profited greatly by the fact that she is ready with a supply when all the other great dairying countries are winter-bound Throughout the dairying districts of Victoria and New South Wales, co-operative factories and creameries are to be found, in which great care is taken to manufacture a uniform product. The total butter production of Australia in 1906 was 159,870,622 lb., having an estimated value of £6,830,000. The value of the butter exports had increased from £1,582,631 in 1899 to £2,331,595 in 1905. The cheese produced in the year 1906 amounted to nearly 15,000,000 lb.

In Victoria the farmers have not only had the advantage of fine natural facilities for dairying, the soils being rich, more evenly watered, and the climate more equable than in other parts of Australia, but they have also had every assistance from the Government in the development of an export trade for their butter and other dairy products Instructors and experts are provided by the Department of Agriculture, and a Government system of grading and stamping butter for export is in operation. With this paternal treatment the industry has shown a big yearly increase. For the official year which ended in June, 1906, the export of butter from Victoria amounted to 40,634,000 lb., the value of which was £1,950,000. In a single year the value of the production for export had increased by £300,000, and in two years by more than £500,000. Adding other dairy products the total export trade in 1906 was over £2,000,000. The profits of dairying are well distributed, there being nearly 47,000 cowkeepers in Victoria. The average yield of milk per cow in 1906 was 328 gal., all cows in dairy herds being included in this calculation.

The other great dairying area, along the broad coastal line of New South Wales, in 1906 produced a total of some 60,000,000 lb. of butter and about 5,000,000 lb. of cheese. The average production per cow has greatly improved in recent years as a result of the close attention which is being given to selection, feeding, and other essentials. Dairy farmers in the better pastured districts obtain a return from their cow of from £8 to £10 per annum, heifers averaging from £6 to £7.

So far as Queensland is concerned, dairying on a large scale is up to the present confined to the southern districts bordering upon the New South Wales northern rivers area. It is chiefly in the hands, however, of experienced farmers from Victoria and New South Wales, who have left those States owing to the difficulty of getting good land at a reasonably low price. The total production of Queensland butter is over 20,000,000 lb. annually. In 1906 some 14,034,000 lb. were exported, the value being £582,300. Six years previously only a little over 1,000,000 lb. annually was exported.

South Australia has also during recent years made no little advance as a dairying and butter-exporting country. Tasmania and Western Australia, although lending themselves admirably in places to dairying, have not yet entered seriously into the export markets. Until recently there has been a notable disposition on the part of Australian dairy farmers to rely almost exclusively upon natural pasturage for their herds. Trusting to a generally beneficent climate, few of them have provided any reserves of fodder to tide them over occasional scarcity. Attention is now being devoted, however, to the improvement of pastures by the cultivation of fattening grasses, and also to the making of stock ensilage for either summer or winter feeding, as necessity arises. The Victorian farmers, guided by the State experts, have taken a lead in this direction, and silos for ensilage existed on some hundreds of farms at the end of 1906.

Horses and Minor Stock. There were in Australia in 1906 a total of 1,673,805 horses, the value of which was officially set down at £22,441,967. In recent years a great demand has been set up by other countries for the sturdy type of horse which has been given the generic designation 'Waler', but which not only New South Wales but several of the other Australian States are ready to supply. These horses are light, low set, and strong loined. For some years a trade has existed with India for horses of this description for army remount purposes, and later many thousands were required for the forces in South Africa, and subsequently for the Japanese army in the field against Russia. These demands, coming so soon after the great drought, have resulted in some depletion of the herds. Efforts are now being made to replenish the breed of 'Walers' by the importation of strong cob sorts and Welsh ponies of a sturdy type, the latter being intended to reduce the height of the progeny.

In New South Wales the number of horses at the beginning of 1907 was about 537,000. Breeders in this State have specially catered for the remounts market. Whilst also sending away a number of horses for army and similar work, Victorian breeders have paid exceptional attention to the development of the draught horse. The Australian draught horse may be generally described as a composite of the Clydesdale, Shire, and Suffolk Punch types. In Victoria the cross between Clydesdales and Shires is most to be found. In order to stimulate the supply of horses of a lighter kind for exportation to India and elsewhere, the Victorian Government has stepped in with a supply of Welsh pony stallions imported from Great Britain, recognizing that there is a practically unlimited demand for Australian remounts. At the beginning of 1907 the number of horses depastured in Victoria was about 400,000.

Queensland also is a competitor in the market for remounts, the breeding of which follows closely upon the lines adopted in New South Wales. There were at the beginning of 1907 some 453,000 horses in Queensland, and the export trade with India and Japan was steadily developing. South Australia has entered the same field successfully with a strong class of horse from the central portion of the colony, capable of undertaking very long journeys on a minimum supply of water and forage. The South Australian horse stock amounted in 1906 to 207,000. Western Australia and Tasmania are still in the position of producing horses in numbers merely sufficient for their own purposes. In all classes, however, breeding is being carried out on sound lines.

The raising of pigs is almost invariably pursued in Australia as a sideline in conjunction with dairying. Not nearly sufficient attention has been given, up to the present, to this branch of farming. Breeders have not succeeded in producing a type of animal which meets with thorough favour on the English market, which under present conditions governs Australian agricultural development to a most material extent. The number of pigs to be found in the whole of Australia in 1906 was only just over 1,000,000, with a value of £1,405,000.

There are a few experimental herds and flocks in Australia of animals such as Angora goats, which are profitably bred in South and Western Australia; camels, which are reared chiefly in those two States for transport work in the interior; and ostriches, conditions for the rearing of which have been found eminently suitable in two or three districts of South Australia.

The Rabbit Pest.—Australia has suffered grievously from the pest of rabbits, unknown on the continent until a few were introduced into Victoria in 1864. In the first place they were carefully protected, but in their new climatic surroundings the rabbits soon showed themselves so prolific and so destructive to pasturage as to become a dreaded scourge in eastern Australia, and trapping and poisoning had to be resorted to on a wholesale scale. Within sixteen years of their introduction they had so grown in numbers that the Governments were compelled to take steps for their suppression. Wire netting, with rabbit traps at frequent intervals, was erected along the boundary lines between Victoria and South Australia, and between New South Wales and Queensland, but these were ineffective, and the rabbit has now ranged over all the eastern parts of Australia, and as far as the borders of Western Australia. Even the remarkable trade which has sprung up in recent years in the exportation of millions of rabbits to England has been inadequate to keep down the numbers, and the profits made by trappers and shippers have only compensated for a moiety of the loss sustained by pastoralists.

Cereal Crops.—What may be called the 'great Australian grain belt' lies on the western slopes of the long mountain ranges which cut through Queensland and New South Wales, on the north of the Dividing Range in Victoria, and over the whole of the north-eastern portion of South Australia. From this huge belt of grain-growing country comes the bulk of the wheat produced by Australia, which in 1906–7 amounted to 66,100,654 bus., the product of some 5,978,000 ac. The output of wheat had tripled in the preceding fifteen years. In the year already referred to there were under oats in Australia some 582,000 ac., the product of which totalled 13,612,000 bus., whilst there were 91,000 ac. devoted to barley, the crops aggregating 1,884,000 bus. In the districts where river flats are to be found, maize-growing is carried on to some extent. The product is a very good one, although there is no doubt some room for improvement in the development of a more mealy quality. The area under maize in 1906-7 was 325,581 ac., yielding 10,172,000 bus. of grain.

The lands within the grain zone vary from a light loamy composition to rich chocolate soil. Unmethodical farming occasions great differences in the productivity of these soils. There is a tendency on the part of wheat farmers to regard themselves as such alone, and to overlook the advantages of crop rotation. The antipodean seasons of Australia render it necessary to sow cereal crops in April, May, and the early part of June, harvesting taking place from the middle of November until the middle of January. The methods of cultivation have improved greatly throughout Australia during recent years, and farmers are realizing the absolute necessity of giving their fields rest in order to secure good yields. A majority of the farmers have a great deal more land than they can put under cultivation at one time. Most of the grain-growing land in these days, when cleared of virgin growths, is practically ready for the plough. In very difficult country, such as the Victorian and South Australian 'mallee' areas, the exceptional local conditions have led to the invention of special implements to facilitate sowing. One ingenious contrivance is known as the 'stump-jump plough', devised to avoid the deep-lying roots of the mallee scrub, a thick growth which gives its name to this district of Victoria and South Australia—now, in spite of its general dryness, rescued from the conditions of a wilderness and converted into fertile wheat-growing country. In addition to the parentage of the 'stump-jump plough', South Australia is responsible for another contrivance for destroying useless vegetation, called the 'scrub-roller', the use of which is of course preliminary to that of the other unique invention.

In their harvesting operations the Australian grain-growers possess a great advantage over those of Manitoba and countries governed by moister climatic conditions. The dry atmosphere, and the consequent 'chippiness' of the grain stalks, renders it possible to employ 'strippers', a combined reaping and threshing machine, and the 'complete harvester', an invention which, although now in large adoption in America, was originated in Australia. These harvesters strip off the heads of the grain, thresh, winnow and clean, and finally bag ready for market. By the use of such machines 9 or 10 ac. of wheat can be harvested in a day in a crop giving 20 bushels to the acre, the cost being about 1½*d* per bushel. Oats, and even barley, are also harvested in the way described. In putting in crops it is the practice among all the larger cereal farmers to use disc ploughs instead of furrow ploughs, traction engines being employed for motive power.

The grain production of Victoria is slightly larger than that of any of the other States. In 1906 an area of 2,070,517 ac. was under wheat, the resultant yield being 23,417,670 bus., or an average of 11·31 bus. per ac. In 1904 the yield from 1,968,599 ac. was 28,525,579 bus., an average of 14·49 bus. These results are the best yet obtained in Victoria, and may be partially attributed to the fact that during the drought period immediately preceding, the ground was perforce rested in many cases. It is worthy of note, however, that in the winter of 1905-6 over 1,000,000 ac. were under fallow, as compared with one-half that area six years previously, when approximately the same quantity of land was devoted to wheat. Artificial fertilizers and the seed drill have also come into general use. Whereas in 1898 only 21,586 tons of artificial manures were used, the quantity in 1906 was 54,674 tons. The Victorian crop of oats in 1906 amounted to 7,232,500 bus., an average of over 23·18 bus. to the ac. The malting barley produced amounted to 645,500 bus., an average of 24·56 bus. per ac., whilst the barley for feed purposes totalled 416,700 bus., an average of 28·43 bus. Large crops of wheat and oats are utilized in Australia for haymaking, and the crops thus produced in Victoria in 1906 amounted to 864,200 tons, the growth of 591,771 ac. Some attention is being given to the growing of maize by the farmers near the rivers of the Gippsland and north-eastern districts of Victoria. The crop harvested in the year under review was 641,200 bus., taken from 11,785 ac. Maize-growing is generally regarded in Australia as a branch of mixed farming rather than an individual industry.

In 1906 the wheat crops of New South Wales were sown on 2,200,000 ac., and the value of the production, together with wheaten hay, was nearly £4,000,000. Little is being done in the growing of barley or oats, but more attention is devoted in this than in any of the other Australian divisions to maize production, the coastal dairymen making it a profitable sideline. About 200,000 ac are kept under this crop, as compared with about 12,000 ac. in Victoria.

The wheat cultivation of South Australia is chiefly confined to the central and northern sections of the colony proper, which between them provide nine-tenths of the aggregate harvest. In 1905, slightly over 2,000,000 ac. were seeded with wheat, this being a considerable reduction on former years. The average of grain reaped was 11·78 bus. The cost of growing wheat is phenomenally low in South Australia. Mr. T. A. Coghlan, formerly New South Wales statistician, has pointed out that 'owing to favourable conditions of culture a yield of 7 bushels in South Australia is financially as satisfactory as one of 15 bushels in New South Wales or 20 bushels in New Zealand.' At the same time, South Australian farmers themselves are recognizing that it is possible to do more with their land, and in 1906 it was estimated that 1,321,000 ac. of wheat lands were artificially manured, as contrasted with only 60,000 ac. ten years previously.

Wheat culture in Queensland is principally carried on in the Darling Downs country, but as yet that State does not play a very important part in the aggregate Australian production. The average productiveness per acre stands at 14·66 bus. Farmers have gone in for maize-growing on an extensive scale as compared with most of the other States, and 113,720 ac. had been seeded with this crop in 1906. Western Australia, though far removed from the great 'wheat belt', is capable of adding very considerably to the output as settlement advances. A good quality of wheat is produced, and the average from 195,071 ac. sown in 1906 was 11·8 bus. Oats are the chief cereal product of Tasmania, where the average of 28 bus. per ac. is obtained. A good market exists for Tasmanian oats in other parts of Australia. The production of cereals, however, is steadily diminishing, mixed farming becoming more and more general.

Mixed Farming. In Australia there has at all times been an indisposition, not readily to be understood, to take up mixed farming. Settlers set their minds upon single avenues of usefulness, such as wheat-growing, sheep and cattle raising, or dairying, maintaining a complete disregard of general farming. The reverses of a few years back, however, have brought about fuller recognition of the fact that mixed production is the surer method. Thousands of agriculturists, who until recent years devoted themselves virtually to a single line, are now widening the scope of their operations.

The State of Victoria may be regarded as having taken the lead in respect to farming as it is understood in most European communities. Varied culture is successfully followed in the western, Wimmera, Mallee, and north-eastern districts as an adjunct of the more stable forms described under other headings in this article. In western Victoria, potatoes are very extensively grown. The total output of potatoes in that State in 1906 was 115,352 tons, produced from 44,670 ac., an average of 2·58 tons per ac. In the same district onions are largely grown, and the average yield per ac. in 1906 was 5·23 tons. A great deal of attention has recently been given to poultry-raising. Excellent stamps of fowls, ducks, turkeys, and geese are produced, and the development of an export trade is impressing the necessity for scientific breeding and management. The value of the Victorian trade in poultry and eggs in 1906 was £1,491,550. Beekeeping is also carried on extensively. For many years Victoria was known as 'the cabbage garden' of Australia, the area within a radius of thirty miles of Melbourne being largely devoted to market gardening. A considerable proportion of this industry throughout Australia is in the hands of Chinese, whose painstaking practices people of European origin are not too ready to follow. The production in Victoria from market gardens is valued at about £200,000 per annum.

Apathy towards mixed farming is still very marked in New South Wales. Even in the growing of cereal crops there has been a great falling off in all branches except the staple of wheat. The production of green fodders has diminished considerably, whilst the raising of vegetable crops is almost entirely neglected, and very little is done in the way of poultry-raising, beekeeping, and kindred pursuits. Similarly in Queensland, South Australia, and Western Australia, mixed farming is still practically a negligible quantity. The only State which vies in any way with Victoria in taking advantage of its natural opportunities is Tasmania, where the farmer is to a very large extent governed by the uncertainty of seasons on the Australian continent. Potato-growing is carried on upon an even larger scale than in Victoria, and these two States to all intents and purposes furnish a supply of potatoes for the whole of the Australian market. The Tasmanian potato crop in 1906-7 was worth over £360,000, an average of 5·31 tons having been obtained per acre. This was a comparatively small output, seeing that a 6 ton average has been recorded. Hops are more extensively grown here than in other parts of Australia. Much attention is also being given in Tasmania to poultry-raising.

Special and Experimental Crops.—The existence in portions of Australia of tropical and semi-tropical conditions has opened up avenues for special forms of production. A number of these are merely in the experimental stage up to the present, and one or two have been practically abandoned, not because of any unsuitableness of soil or climate, but by reason of a not unnatural impatience on the part of the pioneers with experiments when industries of proved profitableness are so ready to their hands.

Queensland, advantaged by semi-tropical conditions over a large area, has made most advance in the development of special forms of agricultural production. The growing of sugar cane is the most important of these, and in fact is one of the most profitable industries the northern State possesses. An area of 134,107 ac. was taken up in cane-growing in 1906, the yield amounting to 1,415,745 tons (of cane). The value of this crop approximated to £2,000,000. The number of sugar-cane farmers was 3422. This industry, however, is at the present juncture in a position of some uncertainty, brought about by the determination of the Federal Parliament to terminate Polynesian black labour, with which it has been developed. The problem remains as to whether a sufficiency of whites can be induced to carry on the work in the cane fields hitherto performed by 'kanakas'. In the southern parts of the Queensland sugar-growing area white labour has already been employed with some degree of success, but it is still a question of contention whether coolie labour can be dispensed with in the hotter and more humid parts. Reliance will probably be placed on the importation of Italians to work some of the fields, this plan having already been adopted in New South Wales, where in the northern-rivers section sugar cane is being cultivated in small quantities. Sugar production has here, however, shown practically no signs of increase during recent years It is worthy of remark that in Victoria an attempt was made some years ago, with Government assistance, to start the cultivation of beet sugar in the Gippsland district The mistake was made of trying to induce farmers to change from profitable dairying and stock fattening to a special branch of industry with which they had no acquaintance, and on a scale insufficient to keep an expensive State-aided factory adequately employed. The sugar produced was excellent in quality, but the experiment was a distinct failure.

The cultivation of tobacco has also engaged experimentalists in various parts of Australia. Up to the present the greatest degree of success has been achieved in the north of New South Wales. There a light leaf is produced which, with riper experience in both growing and subsequent treatment, may conduce to establishment of the industry on a permanent and expanding basis. In western New South Wales, however, a few farmers who have tried tobacco culture are disinclined to follow it up, and the growing of leaf has been left in the hands of a few Chinese. An even worse fate has attended tobacco cultivation in Victoria, where, despite expensive endeavours on the part of the State Government to give it an impetus, a very small quantity of leaf is grown, the output coming chiefly from the valley of the King River, in the north-east. It is to Queensland that most regard will probably be paid, for the time being at least, as a tobacco producer. The vexed question of coloured *versus* white labour may here exercise a retarding influence, but soil and climate in Queensland are alike conducive to the raising of leaf of a good grade, and the tobacco-growing acreage is in this colony not diminishing as elsewhere in Australia, but slowly increasing. At the same time, the growing of the tobacco plant in any part of Australia must as yet be regarded as quite experimental.

All indications go to show that until Queensland and the Northern Territory have developed these and other special lines of production, it would be as well for the States governed by more temperate conditions to confine themselves to the proved branches. Queensland has already done a great deal in the way of cotton-growing. At one time as much as 14,000 ac. was utilized, but in 1885 the industry languished, and it is now quite insignificant. Enough was done, however, to show that cotton could be profitably grown, and during the last two or three years attempts at a revival of cotton culture have been made.

Coffee cultivation is carried on in Queensland to a small extent, the northern division of the colony lending itself more especially to the production of an excellent quality of bean. The Government has assisted in the initiation of the industry by providing facilities for milling, and about 300 ac. were under cultivation according to the latest returns. This is a decrease from 1901, when 547 ac. were devoted to coffee plantations. Queensland is also very suitable for the growing of the indiarubber plant, but the length of time occupied by plantations in reaching maturity has prevented rubber production from advancing beyond the experimental stage. The same may be said with regard to rice— for the growth of which the tropical rain belt is exceptionally suited,- arrowroot, olives, ginger, and other products The Northern Territory is related to Queensland in its productivity. Sugar, tobacco, cotton, rice, flax, and similar growths have been successfully experimented with there, but as in many other places it has been impossible, owing to the limited means at the disposal of the Government, to properly develop this vast area. Western Australia in its northern parts has also proved, by means of Government experiments, that tobacco, flax, fibres, and possibly cotton, may be successfully grown there.

FRUIT- AND VINE-GROWING. — Fruits in the greatest variety and abundance are grown in all parts of Australia. These range from tropical varieties, such as mango, coconut, banana, and the pineapple, to oranges, stone and berry fruits of all kinds Such an unlimited supply is possible, that the home demand, although very large by comparison with those of other countries, is quite inadequate to absorb it. In recent years, cold storage on ocean-going steamers has enabled Australia to rid itself of large quantities of apples and pears, the bulk of these being sent from Victoria and Tasmania. In those two States, fruit-growing has been carried on with thorough recognition of the possibilities of ultimate expansion. Searching precautions have been taken by the respective Governments for the exclusion of insect and fungoid pests, and for the systematic selection of fruits destined for foreign markets. Good methods of cultivation, pruning, and packing have been adopted by the growers themselves. A number of canning and jam factories absorb a portion of the production, particularly of berry fruits. It is estimated that the value of fruit raised for sale in Victoria is £450,000 per annum. Tasmania in 1906 exported fruit and fruit products to the value of about £300,000. In New South Wales, fruit culture has been treated with lamentable inattention, both by the Government and by orchardists. That State, although possessing every advantage of soil and climate for the production of fruits, is still in the stage of having to import from her neighbours. Queensland controls the production of pineapples, bananas, &c. The area of the whole Commonwealth used for fruit-growing is about 200,000 ac.

One of the most interesting features of Australian agrarian life has been the development in recent years of a considerable wine production. Large areas of South Australia, Victoria, and New South Wales have been found suitable, by reason of soil peculiarities and geniality of climate, for the purposes of the vigneron. Australian wines are distinguished by their very full body and iron properties. Vignerons, and especially those of South Australia, have manifested great care in their task, and they have been aided by such stringent Government regulations that pests such as phylloxera, which have been admitted into Victoria and elsewhere, but happily eradicated for the most part, have never been known in South Australia. There is rather too great an inclination among Australian growers to approximate their wines, by blending and fortification, to the European varieties. In the development of the wine industry many years are necessary for a thorough understanding of soils and varieties of stocks, but Australian vignerons show an increasing desire to profit from their experiences. The localities more peculiarly adapted to vine-growing are the western and northern districts of Victoria, the Murray River section of South Australia, the region of New South Wales adjoining the Murray, and the Hunter River valley in the same State. The land under vines in Australia in 1906 was 61,357 ac., the wine produced totalling 5,679,834 gal.

IRRIGATION AND ARTESIAN BORES.—The problem of the semi-arid regions of Australia has a proposed solution in the proper conservation of water supplies and the construction of irrigation works on a large scale. Rivers such as the Murray are at present allowed to discharge waters into the sea which, if conserved, could be utilized for the conversion of huge fertile but at present unreliable tracts into permanent pastures. Perhaps, fortunately, it has been left until the formation of a central Government and the creation of a federal feeling before attempting anything on a scale of very great magnitude. A commission of experts which recently enquired regarding the possibilities of irrigation from the River Murray, which belongs to New South Wales, Victoria, and South Australia, has decided that the irrigation of some 50,000,000 ac. could be carried out by gravitation. Something on a smaller scale has already been attempted by Victoria, the Government of which has diverted a proportion of the waters of the Goulburn River into an immense storage basin at Waranga, from which a large system of distributing channels is supplied during the summer months. Another storage reservoir at Kow Swamp is filled by a channel from the River Murray, and together with another direct channel from that watercourse supplies an irrigation system of 84,000 ac. An irrigation colony has been established at Mildura, on the Murray, where about 9000 ac. have been rescued from the desert, and utilized almost entirely for raisin and other dried fruits production. A similar scheme has been carried out at Renmark, on the South Australian side of the Murray. The New South Wales authorities have done nothing practical in the way of irrigation, although several large schemes have been proposed from time to time. A number of artesian bores have, however, been sunk both by the Government and by settlers.

Artesian supplies can be found in many parts of Australia. Queensland especially has benefited from this source of water supply, some 600 sq. miles of country between Bowen and Townsville having been rendered fertile by means of sinking. In Queensland there are about 1000 artesian bores, the average depth sunk being about 1221 ft., although in some cases water has only been reached by sinking some 4000 ft. South Australia and Western Australia both possess a number of artesian wells.

AGRICULTURAL EDUCATION.—In concluding this summary of Australian agricultural conditions, the Governments of all the States may be congratulated upon having made it their special duty to foster rural industry by every means, and particularly by provisions for agricultural education. The Government of New South Wales has established an agricultural college about thirty miles from Sydney, where 150 students are given a practical and scientific farm training. Smaller farm schools have been established in each agricultural centre. The Victorian Government has established an agricultural college at Dookie, in the north-eastern district, a school of horticulture at Burnley, near Melbourne; and also sends a staff of experts in dairying and other pursuits into all parts of the country to instruct farmers in the most scientific methods. In Queensland the Government has instituted a fine agricultural college and farm at Gatton, and experimental farms exist in various parts of the State. The South Australian Government has been equally alive to the importance of agricultural education, and a large college for scientific farming is in existence at Roseworthy, about thirty miles from Adelaide. Two experimental farms are conducted by the Western Australian Government, one in the south-west and the other in the north-west. The agricultural departments of the various States are assiduous in the publication of journals and records for the instruction of farmers. [T. W.]

Austrian Pine (Black Pine) (*Pinus Laricio* var. *austriaca*).—A large tree with its branches arranged in pseudo-whorls, and needle-shaped foliage leaves arranged in tufts of two which persist from four to six years. It is distinguished by its dark coarse bark. In general characteristics this species closely resembles *P. Laricio* and *P. sylvestris*. The Black or Austrian is distinguished from the Scots pine by its larger leaves and cones, and its coarser and darker bark. The female cones are red when young, and shining yellowish-brown or somewhat flesh-coloured when mature. The leaves are strong and prickly pointed, and the foliage as a whole presents a very dark appearance.

This species forms large natural woods in lower Austria and in the south-eastern Alps, where, according to Schlich, it is found at an elevation of 4500 ft. It is not indigenous to this country, being introduced about the year 1830.

The cones ripen the second autumn after forming, and the seeds are shed the following spring. A good sample should show a germinating capacity of 70 per cent. The seed should be sown broadcast at the rate of 14 oz. of seed to 100 sq. ft. of seed bed, and covered to a depth of ¼ in. The seedlings should remain undisturbed for two years, when they should be lined out at the rate of twelve plants to the yard. After standing two years in the lines they will be ready for final planting out.

The Austrian pine may be successfully used to form pure woods, for on the one hand it is one of the least exacting trees so far as soil is concerned, and on the other it retains a close canopy up to an advanced age. The leaf fall is also good. It is especially valuable for planting thin calcareous soils.

The timber is highly regarded in Austria, but not so in this country, where it holds a reputation for coarseness. More rational methods of planting and thinning would probably, however, do much to remedy this defect. The timber is soft, light, and contains much turpentine. Specific gravity air-dried averages ·56. It is chiefly valuable for building purposes under cover, as unless treated with some preservative it is not durable when exposed to the weather.

The external dangers to which this species is subject are many, and are the same as those to which *P. sylvestris* is liable, especially as regards insects and fungi. The Austrian pine is apt to suffer severely from snowbreak, which evil can be mitigated to some extent by mixing with other species. The most injurious fungi are *Trametes radiciperda* and *Agaricus melleus*, both of which often cause large gaps in the woods. Both insects and fungi cause much less damage in woods of this species than in woods of *P. sylvestris*. [W. F. A. H.]

Automobiles. See Motor Vehicles.

Autumn, from the astronomical point of view, extends from September 22 to December 21 in north temperate latitudes. In general practice, however, the year is popularly divided into autumn, the season of harvest; winter, the season of preparation or of compulsory rest, spring, the season of seeding; and summer, the season of growth. However simple this appears at first, it is extremely difficult so to divide the year even in thought. The yearly cycle of operations has perfect continuity for each of the interests on a particular farm. The morrow of the harvest of any part of one year's yield sees the thought and operations initiated for the next; winter may be a time of sowing, spring a time of reaping, summer a time of securing and of sowing as well as of growing, according to the particular form of crop considered. In popular understanding, autumn is commonly held to include over Great Britain the months of September, October, and November. See arts. on farm calendars for these three months, and on Harvest. [J. St.]

Autumn Manuring.—This has reference chiefly to the practice of applying farmyard manure on the stubble for the benefit of the succeeding green crop, although the operation in many cases is carried out in the early winter months. The term may be also applied to the practice of applying farmyard manure to meadows, which is frequently done early in autumn. It may also refer, however, to the application of artificial manures, such as basic slag or the potash salts, to pasture or cropped land. For the relative advantages of autumn manuring and the system of applying directly in the drills in spring, see art. on Winter Manuring. [J. B.]

Avel Crop.—The word 'avel', found locally also as 'avil', 'aewall', 'awat', is used in Scotland to designate the second cereal or white crop grown in succession after the land is ploughed from lea. Till comparatively late in the 19th century definite rotations were almost universally prescribed in farm leases, and the practice of taking an avel crop and sowing down again to grass without the intervention of a cleaning crop was usually forbidden, or allowed only in special cases under specified conditions. Various circumstances, however, combined to bring about a reconsideration of the general attitude as to what might be included in good husbandry. The introduction of timothy grass, increased cost of labour, the fall in prices of products, better understanding of the principles of manuring, and the unfortunate experiences of successive wet seasons on the heavier and stiffer soils all helped to modify opinion. Avel cropping is now recognized as good practice in somewhat late districts with rainfall above average, where the soil is retentive, and the cultivation and cleaning preparatory to a turnip or other green crop involves expense greater than can be profitably laid out, and a less costly system has been evolved which allows the land to be retained under tillage. The success of this elementary rotation without a fallow crop depends mainly on three conditions: the use of lime or basic slag on the lea before it is ploughed, the restoration of organic matter by a dressing of farmyard manure, and the promotion of a vigorous growth of timothy and similar grasses, which eliminate and keep down weeds. Avel cropping is properly regarded as generally inadvisable on the lighter classes of soils, and commonly results in a considerable growth of pearl grass, which cannot be got rid of by smothering with the strong useful grasses which act as cleaners on heavier land. [J. St.]

Avena.—This is a general name for all oat grasses. The ear is a panicle. The chaff (glumes) of the spikelet is specially long, membranous, and contains two or three flowers. The lower valve of the flower husk (pale) is bearded from the back, and this beard or awn is bent, with a twisted base. In certain highly cultivated varieties of oat the awn becomes rudimentary and may even disappear. On the farm we meet with Wild Oat (*Avena fatua*, L.) growing on the arable land among the oats cultivated for grain and straw. The useless and deleterious qualities of this species give rise to the common expression 'sowing wild oats'. This Wild Oat is easily recognized by its excessive tallness when growing among ordinary oats, by the conspicuous reddish-brown hair on the base of the husk (lower pale), and by the fact that each flower or part of the spikelet has an awn to itself. This troublesome pest in corn is easily carried from one field to another by wind, the hair on the husk making the 'seed' very easy to carry. These 'seeds' may lie in the ground for years without loss of germinating power. When Wild Oat is abundant in the cultivated variety, it may be advisable to cut the corn before it is ripe and use it as hay. Care should also be taken that the seed corn is free from Wild Oat. On arable land another wild oat is common, namely, Bristle-pointed or Shetland Oat (*Avena strigosa*, Schreb.). In the north of Scotland this variety has been cultivated as a bread corn, but as a rule its place has now been taken by better varieties. The Shetland Oat, unlike the Wild Oat, is not conspicuous for its height, but, like the Wild Oat, each husk or lower pale has a beard or awn. The characteristic point is that each spikelet contains two awns or beards, whereas the good oats have never more than one awn per spikelet. Seeds of Shetland Oat are easily recognized in good oats; the farmers sometimes call them 'whites'. Species of oat are also found growing in dry pastures. These perennial meadow species are Narrow-leaved Oat Grass (*Avena pratensis*, L.) and Downy Oat Grass (*Avena pubescens*, Huds.). Both species yield little produce, and stock do not eat them, so these are mere weeds of no agricultural value. Narrow-leaved Oat Grass grows only on moors and hard clays. It is distinguished by its hard, narrow leaf blades, with a prominent keel on the lower surface, and a median depression (like a Pea) on the ribless upper surface. The ligule is very characteristic, having an abrupt acute point. Downy Oat Grass frequently occurs in dry pastures on chalk. The shoots are quite flat, not rounded, its sheaths are hairy, and the leaf blades ribless, with a median depression. These characters render identification easy. Golden Oat Grass, a valuable upland pasture grass, belongs to a special genus, Trisetum (which see). Cultivated oats are considered in the special article OATS.

[A. N. M'A.]

Avens.—The Common Avens and the Water Avens constitute the two species of the genus Geum, nat. ord. Rosaceæ. Both plants are abundant in Britain. See GEUM.

Avenue, from originally meaning simply an approach or road leading to any house or other building, has now become a term specifically applied to belts of trees formed naturally from hedgerow timber along roadways, or planted in parallel lines, or else (a secondary meaning first applied in America) to broad roadways in towns, whether planted with trees or not. Avenues are therefore always artificial in their origin and are a sort of reproduction of, or improvement on, the natural glades formed in old highwoods. Where paths or broader tracks run through old oak woods the vistas obtainable away among the tree boughs resemble the rounded Norman arch, while in beech woods the form adopted rather resembles the pointed Gothic arch. Many quasi-natural avenues have formed themselves wherever hedgerow trees have been allowed to stand thick on both sides of a roadway, and in some parts of Gloucestershire in particular (especially near Almondsbury) fine elm avenues of this kind are to be found along the highroads.

From the fact that Bacon does not specially mention avenues or woodland walks in either his Essays or his Sylva Sylvarum, it seems unlikely that many, if any, existed before the end of the 16th century. 'Queen Elizabeth made a "pleasure walk", but it is doubtful whether she planted the sides of the elm avenue in the Little Park which bears her name' (Menzies, Windsor Park and Forest, p. 1).

In the later editions of his Sylva, Evelyn makes frequent reference to the planting of 'walks and avenues', and even gives a list of the chief of the noblemen and country gentlemen who had thus adorned their estates, although he does not devote any special section to avenues, as he does to groves (which see). In his diary for 1670, however, he speaks of 'the King . . . walking in the Park, which he is now planting with rows of trees'; and again, in 1683, he mentions that at Windsor the 'avenues to the New Park and other Walkes were planted with elmes and limes'. This probably meant the planting of that part of the present avenue which extended from the Castle to the double gates, while supported tradition dates the completion of the planting of the Long Walk, as far as Snow Hill, to the time of William III. It therefore seems probable that if avenue-planting was not actually introduced from France by Charles II on the Restoration, it was at any rate very soon after that rendered fashionable by his example; for during his exile in France he had seen much of this kind of arboricultural ornamentation, which had been greatly developed by André le Nostre (1613-1700), and had reached its height of perfection at Versailles. It seems probable, therefore, that the older portion of the Windsor Castle avenue is one of the oldest in Britain; and it also became the longest, and one of the broadest, when it was subsequently completed, its length being then, from the Castle to the Statue, 2¾ miles. The oldest part, originally planted by Charles II, must have been three-quarters of a mile long, for it then consisted of 1652 trees set 10 ft. apart in four parallel rows, with a distance of 150 ft. between the two inner rows. This short 10-ft.

distance from stem to stem was far too close either for the health of the trees or for ornamental effect; and after the whole avenue was subsequently completed many replantings had to take place, especially on the stiff clay above the double gates. For more than sixty years past the old trees have been fast decaying, and for the last forty-five years partial replanting with oak and elm has been going on.

But as few of our old avenues exceed about two hundred years of age, it seems probable that avenue-planting was not extensively practised until its adoption by the two great landscape gardeners of the 18th century, William Kent (1684-1748) and Lancelot Brown (1715-83), the 'Capability Brown' who remodelled the grounds at Kew, Blenheim, and Nuneham Courtenay.

As regards their special form, avenues may either be in single or in double parallel lines on each side of a drive, single lines being usually, however, the more picturesque

As avenue trees in their partially isolated position form broad crowns of foliage, wide planting permits of finer and more ornamental development than close setting, hence the best effect is obtainable when the trees stand not closer than 40 to 50 ft apart, and the ornamental effect of wide planting is all the greater if the lines of trees be thrown well back from the roadway, especially when the avenues are long, or when Conifers are planted But if a closer, more umbrageous, narrower, overarching avenue be desired, then planting at from 12 to 20 ft. makes the trees run up thickly and induces crown development laterally One advantage of wide planting is that when the time comes, as come it must, that dead or decaying trees have to be replaced, it is easier to raise up a younger generation without all too long a period of transition. For town avenues the plane tree is perhaps the best and hardiest, but for parks and drives on landed estates elm and ash (as at Windsor), horse-chestnut (as at Bushey Park, one of the sights of London in flowering-time), and lime (as at Blair Athole) are all favourite trees Among rarer kinds of trees there is a fine avenue of Holm Oak (*Q Ilex*) at Courtown, Co. Wexford, and of Noble's Fir (*Abies Nobilis*) at Madresfield Court, Worcester Avenues of Lombardy Poplars, so common in France, Holland, and Germany, are too formal for British taste; and the planting of roadsides with fruit trees, as in central Germany, has never been adopted. For avenue-planting large sturdy transplants have to be used, which require the protection of tree-guards, brushwood, &c., till they outgrow risk of damage from cattle, sheep, rabbits, and hares. [J. N.]

Averages.—The average of a series of unequal numbers is their arithmetic mean, that is, the result of dividing the sum of the members of the series by their number. Thus if 29·55, 30·32, 28·73, 29·04 are four readings of a barometer, the average of these is (29·55 + 30·32 + 28·73 + 29·04) − 4 = 29·41. And, generally, if a, b, c, $d \ldots k$, be any n numbers, their average is equal to $(a + b + c + d + \ldots k) - n$.

Averages are used to reduce totals to a common denominator for purposes of comparison. Suppose that we wish to compare the yields of a certain root crop in two farms. One with 30 ac. under crop yields 870 tons, the other with 20 ac. yields 540 tons. The totals do not indicate directly the difference of the yields. But the average yields per acre, 870 − 30 = 29, and 540 − 20 = 27, give us at once a clear idea of the relative productiveness of the farms. This class of averages is well known in cricket. In cricket averages we consider the skill of the player shown not so much by the actual number of runs obtained or wickets taken, as by the number of runs per innings, or the number of runs per wicket. A particular case of the use of such averages is percentage. An increase of 50,000 in the populations of London and Edinburgh means an increase of 1 per cent in the one case and 18 per cent in the other, and the true significance of the increases can only be appreciated by thus comparing the average increases for each 100 inhabitants.

If the value of a quantity has to be determined from the results of a number of experiments, the determined values may be inaccurate through faults in the indications of the instruments used. Errors are also introduced by uncertainty of observation. The faults of the instruments are as far as possible determined and allowance made for them, or they are eliminated by changes of method The errors due to uncertainty of observation are as likely to occur in excess as in default, and are eliminated by taking the average of the results of a number of observations. The separate results from which the final result is calculated are not always equally reliable The specific gravity of a piece of metal is found by one observer from one experiment to be 9·742; by a second observer, taking the average of two experiments, to be 9·690; by a third from three experiments to be 9·701. The third of these values is more reliable than the second, and the second than the first And this is taken into account in the final average by assigning 'weights' to the values to the first, the 'weight' 1; to the second, 2, to the third, 3, these being the number of observations made. The final result is the 'weighted average'

$$= \frac{9{\cdot}742 + (9{\cdot}690)\,2 + (9{\cdot}701)\,3}{1 + 2 + 3} = 9{\cdot}704,$$

which is simply the mean of all the observations taken

If $r_1, r_2, r_3 \ldots$ are results of weights $w_1, w_2, w_3 \ldots$, the 'weighted average'

$$= \frac{w_1 r_1 + w_2 r_2 + w_3 r_3 + \ldots}{w_1 + w_2 + w_3 + \ldots}.$$

At three lamb sales in a county the average prices are 10*s*, 15*s*., 17*s*. The average of these, $\left(\frac{10 + 15 + 17}{3}\right) = 14s.$, gives only a rough estimate of the selling price of a lamb in the county. If the numbers sold at the sales are respectively 3950, 5270, 8680, we find the average price to be

$$\left(\frac{3950 \times 10 + 5270 \times 15 + 8680 \times 17}{3950 + 5270 + 8680}\right) =$$

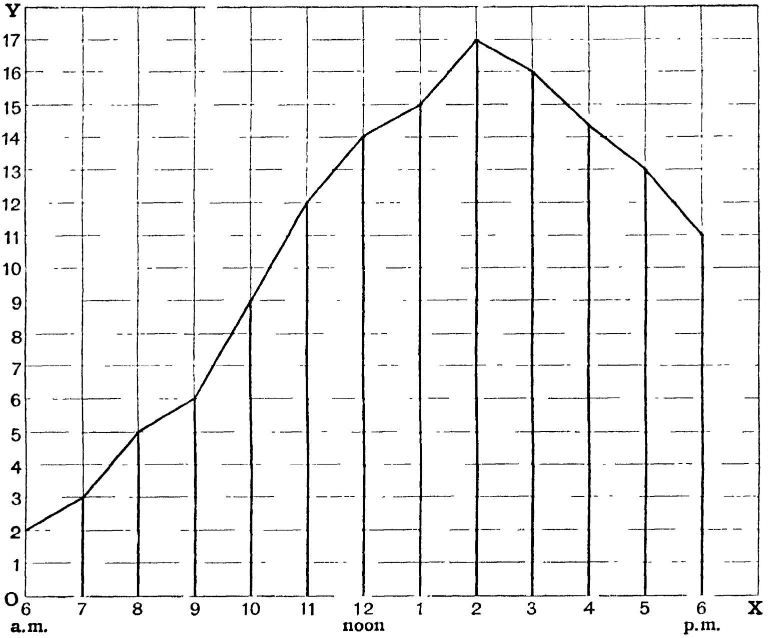
14*s.* $10\frac{2}{3}d$ But if we assign to the prices 10*s.*, 15*s.*, 17*s.*, the 'weights' 4, 5, 9, which are approximately proportional to the numbers sold, we find the 'weighted average' to be

$$\left(\frac{4 \times 10 + 5 \times 15 + 9 \times 17}{4 + 5 + 9}\right) = 14s.\ 10\tfrac{2}{3}d.,$$

which only differs from the true average by a very small fraction 'Weighted averages' can thus be used to avoid lengthy numerical calculations. They are also largely used in works on statistics in connection with questions of wages, price of commodities, &c, where the numbers of wage earners and amounts of commodities can only be estimated approximately.

The longer a list of figures the more difficult it is to grasp in its entirety. While an average is useful as giving a summary of a group of values, a diagram can often be used to make the whole group intelligible in its entirety. Suppose the following table gives readings of a Centigrade thermometer at intervals of one hour —

a m	6	7	8	9	10	11	12	1	2	3	4	5	6	p m
Degrees	2	3	5	6	9	12	11	15	17	16	14	13	11	



To exhibit the changes of temperature in a diagram, take a line, OX, parallel to the foot of the paper, and a line, OY, perpendicular to it. Mark off along OX equal lengths, each to correspond to an interval of one hour. The points of section will correspond to the times 6, 7, 8, &c , o'clock At each point of section of OX raise a perpendicular to OX containing as many units of length as there are degrees in the corresponding temperature reading The broken line joining the extremities of these perpendiculars exhibits the rapidity and amount of the rise and fall of the temperature. Lengths measured along OX are called abscissæ, and perpendicular to OX ordinates The units for abscissæ and ordinates need not be the same, and should be chosen, after consideration of the values to be represented, to give as large a diagram as the paper will admit. The diagrams are most conveniently constructed on squared paper. [R J. T. B]

Aviary, a structure devoted to the keeping and propagating of birds. The plan and design of an aviary may be after any pattern which the fancier may decide upon, but several points require to be observed in order to maintain the health and comfort of the birds. Thus it ought to be spacious enough to allow a considerable freedom of flight and abundant facility for exercise It should preferably face the south or south-west, and be sheltered from the north and east winds. It may be constructed entirely of wire, but it is desirable to have part at least roofed over to afford shelter in winter and shade in summer. The flooring may be of turf, which looks clean, with gravel walks through it to receive droppings from the perches above them and so facilitate cleaning. The gravel should be renewed periodically A constant supply of fresh, and if possible running, water is necessary, and should not be neglected Evergreen shrubs should be planted to afford covers The aviary may be open to the air, unless in the colder districts or where foreign birds are included in the selection. In the latter case the aviary must be a closed structure, with suitable means for ventilation and artificial heating. A glass front with evergreens and ornamental plants growing in a 4- or 5-ft. space between the glass and the netting answers admirably

It is well to restrict the selection of birds for an aviary to those which are purely graminivorous, as these are best calculated to thrive with ordinary care Insectivorous birds are a source of constant trouble and apt to suffer in health, while carnivorous birds are obviously out of the question The feeding should be varied frequently, and should include a selection of such seeds as buckwheat, canary, hemp, rape, plantain, dock, &c Snails, slugs, and worms will occasionally furnish an appetizing morsel, while green food—lettuce, cress, chickweed, &c is always useful [J. B.]

Avogadro.—Count Joseph Avogadro di Casanova, one of the outstanding figures in the agricultural history of Italy, devoted his life to the culture and improvement of his extensive estates in the neighbourhood of his native town of Vercelli, in Lombardy, and also to the solution of problems of agricultural interest His most notable literary efforts are a treatise on the improvement and irrigation of meadows and a book entitled 'Rural Counsels', in which he described the results of his own cultural experiments He was born in 1731 and died in 1813. [J. B.]

Awalding.—Awalding, or lying awald, is the term applied to a sheep which has rolled over on its back, and which finds itself unable to rise except with the help of the shepherd or with the stimulus given to extra exertion by the near approach of the shepherd's dog Awalding is caused by the attempt of the sheep to relieve themselves, by rolling on the ground, of the itch caused by vermin, and the only preventive is to dip the sheep so frequently as to keep them clear of all parasites. Its occurrence is very frequent in warm weather, before shearing time, when the sheep are carrying a heavy coat of wool, but it is perhaps most to be dreaded with ewes near the lambing, as they die very quickly if assistance is not forthcoming. On sloping ground on a hot sunny day, and especially if the sheep happen to be lying with the head downwards, death occurs in a surprisingly short time. Pastures which have formerly been ploughed are particularly dangerous, as the sheep are very apt to roll themselves into the furrows and are quite unable to get out again. In spring and early summer shepherds have to exercise constant watchfulness to prevent losses from this simple cause. [R. P. W.]

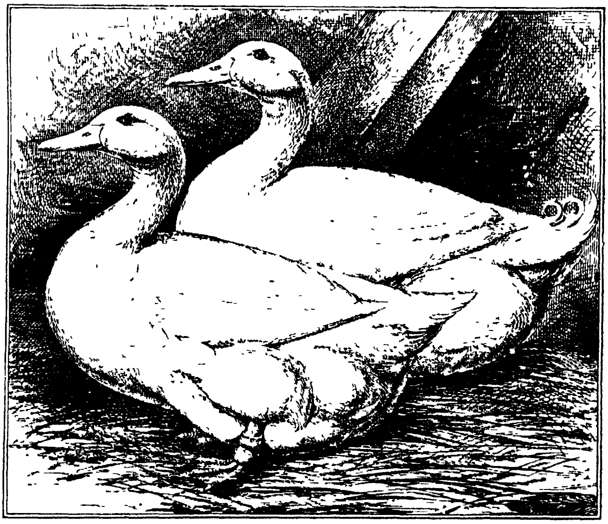
Award, the formal decision given by an arbiter or oversman upon any matter submitted to his judgment. See ARBITRATION

Awn.—This name is applied to a slender process which grows out from the apex, the back, or the base of the lower valve of the husk (lower pale) of certain grasses The common name is *beard*. A bearded oat, for example, is one which has an awn springing from the back of the husk: a beardless oat has no awn.

The presence of an awn is sometimes a useful mark of distinction Italian Rye Grass has an awn, Perennial has none, Hard Fescue 'seed' has an awn, Sheep's Fescue 'seed' has none. [A. N. M'A.]

Awnless Brome Grass.—A tall, perennial grass with long rhizomes and smooth leaves, grown extensively on dry soils in Hungary, and hence sometimes termed Hungarian Forage Grass See BROME GRASSES.

Aylesbury Duck.—This, the premier British duck for profitable purposes, takes its name from the capital town of the county of Buckinghamshire, which has been for a long time the great centre of duck-breeding in this



Aylesbury Ducks

country. In the early part of last century and previous to that period it was generally called the 'white English', but from the fact that the best specimens were bred in the Vale of Aylesbury the present name was gradually assumed. Owing to its rapidity of growth, the breed is specially suited to meet the requirements of our markets, more especially in respect to the spring-duckling trade.

In appearance the Aylesbury duck is boat-shaped, that is, the line of the keel is level with the ground, the legs placed about midway in the body. This fact should be kept in view, because it indicates one of the great differences between this and the Pekin duck. The body is long and broad, with a considerable depth, though in breeding stock the mistake is often made of seeking for birds which are too deep, for when that is the case the birds are much less active, and lose in prolificacy The chest should be carried well forward, otherwise the breast will be too short in length. The neck is of moderate length, surmounted by a long and straight head, and a long, broad bill. The last-named is most important in respect to its colour The ideal is that it shall be of the same tinge as a lady's finger nail, that is, flesh-coloured, for this is an indication of the colour of the flesh, which must be creamy-white. A yellow bill means yellow flesh, and a rough, coarse bill is accompanied by coarse texture of flesh. The legs are stout and heavy, and rather short, and the feet well webbed, the colour being bright orange. The wings are large and strong, and carried well up to the body. The colour of the plumage is pure white throughout, with not the least tinge of cream or canary. Where the latter is found it reveals the presence of Pekin blood, as there has been a considerable amount of crossing between the two races. The sexes are similar in appearance, but the males have curled feathers in the tail, and generally are rather larger in all respects, though that is not always the case.

Under proper conditions the Aylesbury duck is found to be very hardy, and able, both in respect to old and young stock, to bear a considerable amount of exposure They thrive better when at liberty, and especially where there is water in which to disport themselves In fact, that is a necessity for breeding stock, but, as shown elsewhere (see DUCK BREEDING AND REARING), young ducklings intended for early killing grow much faster if they are kept in strict confinement, without water in which to swim. The ducks are excellent layers, and it is no uncommon thing to secure an average of 150 eggs per annum. Cases could be cited where one of these birds laid between 80 and 90 eggs without cessation, and, as a rule, these are very fertile. Adult drakes weigh 9 to 10 lb. and ducks 1 lb. lighter, but, as already mentioned, the great merit of the breed is the rapidity with which the ducklings attain killing age. As they cast their first feather when nine to ten weeks old, they must be killed before that time if they are to be ranked as ducklings. When once they have moulted they can only be sold as ducks, and their value is considerably reduced. By a proper system of rearing at the age named they will reach 4½ to 6 lb., and thus they are rapidly turned into money, as it takes less than thirteen weeks from the time the egg is laid to placing the dead bird on the market. This duckling trade is during the spring months of the year, and hence the quality of rapid growth is of supreme importance. Probably it is true that the flavour of the flesh is not nearly so fine as that of mature autumn ducks, but by reason of the fact that the prices obtained are much greater in the spring, and the cost of production is much less, the balance of favour is distinctly on the side of the breed which meets the special trade requirements. [E. B.]

Ayrshire Cattle. — No authentic record exists of how and when this breed originated. To all appearance it is the most recent of the dairy breeds; the wonder, therefore, is that we have not more reliable information as to its origin. The Ayrshire is one of the most distinctive of breeds; it is surprising, therefore, that it should have been brought into existence without special note being taken of its presence, particularly as it was markedly different in colour, size, horns, and milk yield from the class of cattle common all over the surrounding country. Among those who have investigated the matter there is considerable difference of opinion as to whether the breed should be considered an old variety imported into a new district, and doubtless somewhat modified by its surroundings, or an improvement of the existing breed by selection at home and by crossing with importations from abroad In the following pages all available and reliable records will be quoted or referred to, so as to provide a more complete history of the breed than has hitherto been attempted or even been possible

The most reliable fact which we have regarding the origin of the breed is that it came into existence in the district of Cunningham in North Ayrshire, at or near the parish of Dunlop. Regarding this none of the old writers have any doubt whatever; it may therefore be accepted as an agreed-on fact A careful scrutiny of every available source of information for 300 years back clearly indicates that at that date no breed existed in that district in any way resembling the present Ayrshire, nor was any one known by that name or description. Between the middle and the end of the 18th century the breed now known as the Ayrshire generally received the name of Dunlop cattle, and seems to have been fairly numerous, and to have been well known for a considerable distance from that parish. At the end of the 18th century they were generally referred to as the Cunningham breed, Dunlop being in the district, or bailliary as it was called, of Cunningham. The name Ayrshire seems to have been first applied to them early in the 19th century, and may be seen in the newspapers of 1814, where they refer to the premiums given in Kyle in that year by the Highland Society, for bulls and heifers of the Ayrshire breed.

It is, however, worthy of note that before there was a breed known either by the name of Dunlop, Cunningham, or Ayrshire cattle, that same district was already famous for its butter. In the Topographical Account of the District of Cunningham by Timothy Pont, written about 1600, when referring to this same part of Ayrshire he says. 'The 2d degree and parte of this countrey, being a grate deall louer then the former, and for the most pairt 3 or 4 mylles bredth, is much more fertile in corne and store, being of a deipe, fatt clayeisch soyle, much enriched by the industrious inhabitants lymeing of their grounds, quherby the pastures heir, since this experiment ves practised, is become much more luxuriant then befor; quhence it is that this pairt of the countrey yeilds a grate deall of excellent butter, as all the countrey besyde, but especially the parishes of Steuartoune and Dunlopp. The butter of this countrey in effecte serves a grate pairt of the kingdome, one aker of ground heir yeilding more butter then three akers of ground in any of the next adiacent countreyes.'

The whole district from Kilmaurs through Stewarton and Dunlop forms a very good grazing country, but the pastures, although good, are in no way exceptional, and it is just as likely as not that the great yield of excellent butter to which Pont refers was as much the result of superior cows as of 'deep, fat, clayish soil'. He, however, makes no reference to the cattle, but from later writers we learn that they were generally 'black or brown, with white or flecked faces, with white streaks along their backs'. That is how Fullarton describes them, in 1793, in his General View of the Agriculture of the County of Ayr.

While the prevailing colours of the Ayrshire of the present day are generally a mixture of brown and white, with some entirely brown, but more almost wholly white, there are a few almost entirely black, but a larger number of a more or less equal mixture of black and white. In view of the difference of opinion as to the origin of the various colours in the Ayrshire, it may be mentioned here that although there is now only one herd in existence in Scotland, viz. at Cadzow Forest, Hamilton Palace, of what are presumed to be the original White Cattle of Scotland, there were others at no very remote period in the very district in which the Ayrshire originated. By various writers these have been referred to as Caledonian cattle.

In Bannatyne's Journal, page 521, it is stated that the Earl of Lennox was accused of destroying 'the quhit kye and bullis' in the forest of Cumbernauld. It is further added that 'that kind of ky and bullis has been keepit thir money zeiris in the same forest, and the lyke was not mantenit in ony other pairts of the ile of Albion'. We are told by Robertson in his Rural Recollections, that Alexander, Earl of Eglinton, had at his castle at Ardrossan a herd of these cattle, and that they continued to inhabit the parks around the castle till the year 1820, and that when removed from there at that date, part of them were taken to Duchall, in Renfrewshire. As is well known, these cattle are all of a creamy-white colour, with black noses, and black on the tips of the ears, horns, and tail, and they have black feet. In all points of formation, other than the development of the udder, the Ayrshire of the present day very closely resembles these animals, and the white specimens of the breed do so in an exceptional degree. It may well be asked what influence the ancestors of these cattle have had on the colour and general build of the Ayrshire of remote times or even of the present day.

The statistical report on Ayrshire published under the auspices of the Board of Agriculture in 1794, was written by Colonel Fullarton of Fullarton, in the district of Cunningham, and proofs were circulated throughout the county for correction before it was published. It may therefore be accepted as a most reliable report, and Fullarton's remarks on the Ayrshire breed of cattle must carry full weight. He says:--

'In Cunningham, or the northern division of the county, a breed of cattle has for more than a century been established, remarkable for the quantity and quality of their milk in proportion to their size. They have long been denominated the Dunlop breed, from the ancient family of that time, or the parish where the breed was first brought to perfection, and where there still continues a greater attention to milk cows and dairies than in any other part of Scotland.

'The cattle in this district appear originally to have been of the old Scotch low country kind.[1] Formerly black or brown, with white or flecked faces, and white streaks along their backs, were prevailing colours. But within these twenty years, brown and white mottled cattle are so generally preferred as to bring a larger price than others of equal size and shape if differently marked. It appears, however, that this mottled breed is of different origin from the former flock, and the rapidity with which they have been diffused over a great extent of country is a singular circumstance in the history of breeding. Indeed, it is asserted by a gentleman of great skill and long experience,[2] that this breed was introduced into Ayrshire by the present Earl of Marchmont, and afterwards reared at the seat of the Earl of Glasgow, from whence they are said to have spread all over the country.

'The breed is short in the leg, finely shaped in the head and neck, with small horns, not wide, but tapering to the point. They are neither so thin coated as the Dutch, nor so thick and rough hided as the Lancashire cattle. They are deep in the body, but not so long, nor so full and ample in the carcass and hind quarters, as some other kinds. They usually weigh from 20 to 40 English stone, and sell from £7 to £12, according to their size, shape, and qualities. It is not uncommon for these small cows to give from 24 to 34 English quarts of milk daily during the summer months, while some of them will give as far as 40 quarts, and yield 8 or 9 English pounds of butter weekly. The breed is now so generally diffused over Cunningham and Kyle, in Ayrshire, that very few of other sorts are reared on any well-regulated farm. The farmers reckon that a cow yielding 20 quarts of milk per day during the summer season will produce cheese and butter worth about £6 per annum.'

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[1] Some of the old writers refer to these as Calder cattle. The district of Calder or Cadder is north of Glasgow, in the county of Lanark.

[2] Mr. Bruce Campbell.

Further on he says: 'It is remarked that the best of these milch cows are good feeders, and easily fattened, although their shapes in several points are different from those approved by connoisseurs. It appears, indeed, that the qualities of yielding large quantities of rich milk, and of fattening with facility, on a moderate portion of food, are by no means incompatible. And that the reason of these desiderata being seldom united in the same animal, arises rather from the different views with which stock is bred, and the inattention of farmers to the double objects in question, than to any difficulty in correcting the shape of the best milch cattle, and rendering them equal in form and aptitude of fattening to the most approved breeding stock.'

'In former times a proportion of Dutch or Holderness cattle had been propagated, and when well fed yielded large quantities of milk. But they were thin-haired, lank in the quarters, and delicate in the constitution, which rendered them unfit for a soil and climate such as Ayrshire. They were besides extremely difficult to fatten, yielded little tallow, and from the sparseness of their shapes, incapable of carrying much flesh upon the proper places.

'Alderneys and Guernseys have also been occasionally introduced, in order to give a richness and colour to the milk and butter, which they do in a degree superior to any other animal of the cow species.'

There are many points in the above extracts which merit attention, but only a few of the more important will be alluded to. In the first place it will be noticed that Fullarton says that 'a breed of cattle has for more than a century been established', and further on he refers to Mr Bruce Campbell claiming that this breed was introduced into Ayrshire by the Earl of Marchmont. Mr Bruce Campbell was factor to the Earl of Marchmont. Later writers—Aiton particularly, who wrote a book which was published in Glasgow in 1811, on the Agriculture of the County of Ayr—assert that the date when the Earl of Marchmont introduced the cattle referred to was 1750, which, as is shown by Robertson later on, must have been ten or twenty years before this date.

In the report on the county of Renfrew, published in 1794, the writer, when referring to the parish of Mearns, says: 'It is all inclosed. The parks or inclosures consist of from eight to twelve acres, renting at from £1, 10s. to £2. They are stocked with the finest milch cows anywhere to be seen, mostly of a brown and white colour; purchased chiefly in Ayrshire, when in calf, at from £8 to £10 each. They never breed cattle in this part of the country, but always sell their calves when dropt, at from 4*s.* to 6*s.* each.' This description would accurately apply to the cows in that parish at the present day.

In the corresponding county report for Lanarkshire, or as it was then called Clydesdale, considerable space is devoted to dairying and milk cows, but in the original report nothing is said about their breed or colour. A second edition was published in 1798, and a third and enlarged edition in 1806. In the chapter on cattle in the last edition, the writer, Naismyth, makes the following remarks: 'Upon these principles, handsome cows, weighing from three to four hundredweight the four quarters when fat, are bred in different parts of the country; and more attention has been paid of late to obtain the desired appearance. The colour is mostly brown, with spots of white, the hair thick set, soft, and sleek; the head and neck lean and slender; the ears small and neat; the limbs short, small, and clean boned; the chest rather round than deep at the heart, the shoulders, and more especially the loins, broad and square, the back from the shoulder to the descent of the rump quite straight; the tail long and small. Some aim at having cows without horns; but when there are horns, they are small at the root, not long, and pretty erect.

'This valuable breed of cattle are in greater perfection in the northern district of Ayrshire and the neighbouring county of Renfrew, and it is probably from thence they are derived; numbers of young cows from these quarters being brought for sale to the fairs of Rutherglen. The inferior breeds of cattle are gradually giving way to these through the whole county, and the size of the cattle is increasing in proportion to their feeding.'

In several of the reports of the other counties of Scotland, reference is made to this same breed of cattle from Ayrshire, notably in those on Dumbarton, Dumfries, Roxburgh, and Wigtownshire. Those for Peebles, West Lothian, Perth, Banff, Moray, Berwick, Roxburgh, and Lanarkshire also refer to Holderness cattle as having been introduced.

Had it been the case that the present breed of Ayrshire cattle were descended from certain animals said by Aiton to be imported in 1750 by the Earl of Marchmont, it would have been physically impossible for these few animals to have increased to such an extent as to have stocked Cunningham and Kyle in forty-four years, and have at the same time set up a flourishing trade in surplus cows with the Mearns. Not only so, but this trade seems to have been firmly established for years before 1794, for at that date, and for years before, the farmers of that parish had ceased to rear cattle, as they found they could easily and cheaply supply themselves from Ayrshire. Over and above the stocking of North Ayrshire, and more or less of Renfrewshire, a large part of Lanarkshire was also stocked by this breed of cattle, besides considerable numbers in various other counties, all of which clearly indicate that the breed must have been fairly numerous and well established long before the introductions by the Earl of Marchmont, for there are records of introductions of new cattle by several county gentlemen in the years between 1750 and 1760, extracts in reference to which will be given later on.

It will be noticed that although Fullarton wrote in 1793, he did not state the year in which the Earl of Marchmont was said to have introduced the new breed of cattle, nor does he express any opinion what that breed was. Aiton, writing in 1811, says this happened in 1750; but Robertson distinctly proves that this particular introduction must have occurred between 1724 and 1740.

The Mr. Bruce Campbell referred to by Colonel Fullarton in 1793 as the gentleman who claimed that the Earl of Marchmont had introduced the first of the present breed of Ayrshire cattle, is specially referred to by George Robertson, who wrote an excellent report of the district of Cunningham in 1829. Mr. Robertson was factor for Hugh, twelfth Earl of Eglinton, to which position he was appointed in 1811. On page 569 of his book on Ayrshire, when referring to Mr Bruce Campbell's statement, he says: 'This Mr Bruce Campbell was, I presume, of Milrig, in the parish of Galston, and was born about the year 1730, as I know from the family history, and the Earl of Marchmont alluded to must have been that Alexander Hume Campbell who married Margaret Campbell, heiress of Cessnock, in the same parish, and who became Earl of Marchmont in 1724, and died in 1740. The introduction then of this dairy stock must have happened betwixt these two dates, or about from ninety to one hundred years ago, and so far corresponds with the traditionary account. From what particular part of the country they came there is no evidence. My own conjecture is that they are either of the Holderness breed or derived from it, judging from the varied colour, or what is still better evidence, the small head and slender neck, in which circumstances they bear a striking resemblance to them. In the year 1800 I found a similar breed on the lands of Colgarth, the property of the late Dr. Richard Watson, Bishop of Landaff, by the Winandermere in Westmorland, which had been brought there direct from Holderness'. Mr. Robertson also states that general efforts were being made for the improvement of the Ayrshire breed by careful selection of the calves.

The Rev. William Donaldson, minister of Ballantrae, wrote in 1811 an account of the agriculture of South Ayrshire, for the fourth volume of the Transactions of the Highland Society. Speaking of the Dairy, on page 472, he says: 'Scarcely any other kind of horned cattle is to be seen, than the well-known Cunningham breed of milch cows'. This is rather a remarkable statement, especially when considered along with that made by Aiton, who wrote in the same year (see Farmers' Magazine of 1811, vol. viii), that Fulton of Beith was the first to introduce Cunningham cows into South Ayrshire in 1790. It is therefore evident that these cows must have spread with great rapidity to have so effectively displaced the previous breed in twenty-one years.

In 1812 the same writer has a report on the agriculture of the Rhins and Machars of Wigtownshire in vol. iv of the Highland Society's Transactions, in which the following occurs.—'The dairy husbandry has been set up by strangers coming from Ayrshire, and has since been followed by some of the native inhabitants. . . . The superior profits which this system affords may lead to its continuance and increase; but how far these circumstances may interfere with the favourite employment of rearing and feeding the finest cattle, and whether the blood of the native breed (confessedly a most valuable one) may not be gradually contaminated by the dairy cows introduced from other counties, are questions that will deserve the most serious consideration.' Much follows in the same strain, and for the first time we find the writer using the expression 'the true Ayrshire breed of milk cattle', whereas in writing the report on South Ayrshire the year before, he used the name 'Cunningham breed of milch cows'.

In 1793 Fullarton says: 'In former times a proportion of Dutch or Holderness cattle had been propagated'; and Aiton says: 'About the year 1760, or between that and 1770, some noblemen and gentlemen, who residing in the eastern and southern counties of Scotland, procured cows of some English or Dutch breed, who were very much larger in size than any other in Scotland, and when they were well fed, on the sheltered and improved lands round the seats of their owners, they yielded far more milk than the native cows. It was their greater size, and the superior quantity of milk they yielded, that induced these noblemen and others to purchase them, and wherever their feeding in Scotland corresponded to what they had been accustomed to, their owners were not disappointed. But when these large cows were turned into pasture that was much inferior to that on which they had been reared, they fell short in milking, as all cows that are not well fed will do.

'I am really uncertain as to the district or country from which these stranger cows were brought. They certainly were denominated Dutch cows when first introduced into Ayrshire. But from their being of a brown and white colour, I am disposed to believe they were of the Teeswater breed.'

Further on Aiton says: 'John Orr of Barrowfield, Esq., about the year 1767, sent from Glasgow or from some part in that neighbourhood, to his estate of Grougar, Ayrshire, several fine cows of a much larger size than any then on that estate. One of these cost £6, which was more than twice the price of the best cows in that quarter. As these cows were well fed, they yielded a good return in milk, and the farmers in that neighbourhood were eager to procure their calves, in hopes of obtaining similar returns. Cattle of the same appearance were about that time brought to Eglinton, Loudon, and to the seats of other noblemen and gentlemen in Ayrshire; and as most of those were of the same colour, brown, spotted or freaked with white,—as all of them were larger, and when duly fed, yielded much more milk than the native breed,—their calves were reared by such as could procure them, and bulls of that breed, or even of their colour, were preferred to all others. From these or from crosses of them with the native cows, the whole district has been stocked, and the breed has attained such celebrity that they have not only supplied the counties of Ayr, Renfrew, and the greatest part of Lanark, but for about twenty years past, colonies of the improved breed have been carried from Ayrshire to every county of Scotland, and to many counties in England.'

Another remark of Aiton's is worthy of consideration, as it has an important bearing on the early history of the breed. When speaking of the introduction of the new cows he says 'They certainly were denominated Dutch cows when first introduced into Ayrshire.' This is generally corroborated by the other early writers, although not so distinctly, but tradition also says the same. As has been shown by various extracts, several breeds were introduced, but the main ones were probably those of the Holderness district round the mouth of the Humber. The cattle referred to as coming from here, might first come from Holland, as most of the early writers seem to refer to them as being one and the same breed, or as Dutch breeds. The changes Aiton refers to, instead of being the result of twenty years' judicious selection and crossing, are much more likely to be those of one or two centuries.

Aiton gives two very good illustrations, one of a cow, the other of a bull of the Ayrshire breed. The points in these compare very favourably with those of the best specimens of the breed of the present day. In one particular only they differ materially, *viz.* in the udder. In these drawings the udder is circular, much like what we see it on the Jersey of the present day, or as one of the old writers said, in shape it should be like a large soup plate. The ideal shape at the present time is a flat sole, extending as far forward as possible, and tight and square behind. The illustration of the cow droops a little at the tail head, but the bull, according to present-day ideas, is better there. These drawings were reproduced by Harley in his book on the Harleian system of dairying, published in 1829.

As was to be expected, the early writers on the history of the Ayrshire at times more or less contradict each other; but the general weight of evidence seems to prove almost without doubt that the Ayrshire is a development of the cows which gave the great quantity of butter referred to by Pont in 1600 as being produced in the district of Stewarton. But there is nothing to show whether these cows were of the White or Black breeds. The probability is that considerable improvements in size, figure, colour, and milking capabilities were brought about by the introduction of new blood from various breeds, and that the largest drafts of these came from Holderness and Holland, more especially as the earliest specimens of the improved breed were popularly referred to as Dutch cows. From the close association which existed before, at, and after the Reformation, between Holland and Scotland, it is probable that cows would be brought from Holland very much earlier than even those which have been recorded. Owing to the difficulty and slowness of communication between the two countries, cattle would be very unlikely to be brought in sufficient numbers to account for their great increase here, or that they were bred from the few of the importations of which we have definite knowledge. It seems, therefore, much more likely that from the beginning of the 17th century or earlier there were repeated importations to Hull or Leith, and that from there they were taken to Ayrshire and the Calder district of Lanarkshire.

An objection taken to the view that the Ayrshire breed is a direct descendant of the Dutch is that the colours of the former are now generally brown and white, while the Dutch cattle are commonly understood in this country to be all of pure black and white colours. But an examination of the pictures of Dutch cattle to be seen in many picture galleries of the Hague shows that the prevailing colours of the Dutch breed were not black, but red and brown with white. This is seen in the pictures of Potter, the great Dutch animal painter of the first half of the 17th century; in those of Verboeckhoven, who flourished in the latter part of the 18th century; and of Robbe, whose work was done in the early part of the 17th century. In the pictures of Stobberts, executed about the middle of the last century, some of the cattle are shown as red and white, and some as black and white, while in the works of more recent painters the cattle are generally represented as black and white. These silent pictures tell their own tale, which seems to be that during the 17th century the prevailing colours of Dutch cattle were red and white, and if any black and white ones existed, they were in such limited numbers that they were not thought worth representing, and it is only in paintings executed about 1800 or later that black and white cattle seem to have become common.

Moreover the Dutch cattle of the present day are not all black and white, as in this country is very generally supposed. In the province of Gelderland few cattle are seen but those that are red and white, and even in Friesland, the home of the black and whites, there are numerous herds entirely composed of animals which are red and white. What is more, both are alike eligible for the Friesland Herd Book, only they are seldom bred together, and in the Herd Book are kept separate. These cattle of both colours are somewhat larger than the Ayrshire, they are stronger in the bone and smaller in the horn, but in other respects they very closely resemble that breed. In no case is the difference greater than one would expect after 200 or 300 years' residence in a more northern climate, where good shelter and selection must each have played an important part in developing the present race of animals.

How or when the change from black and white to red and white began in Dutch cattle, is a matter which does not concern us here, but it is well known that no animal characteristic can be so readily or completely changed as that of colour.

On all these grounds, therefore, there seem to be strong reasons for believing that the Ayrshire breed of cattle is not a development from

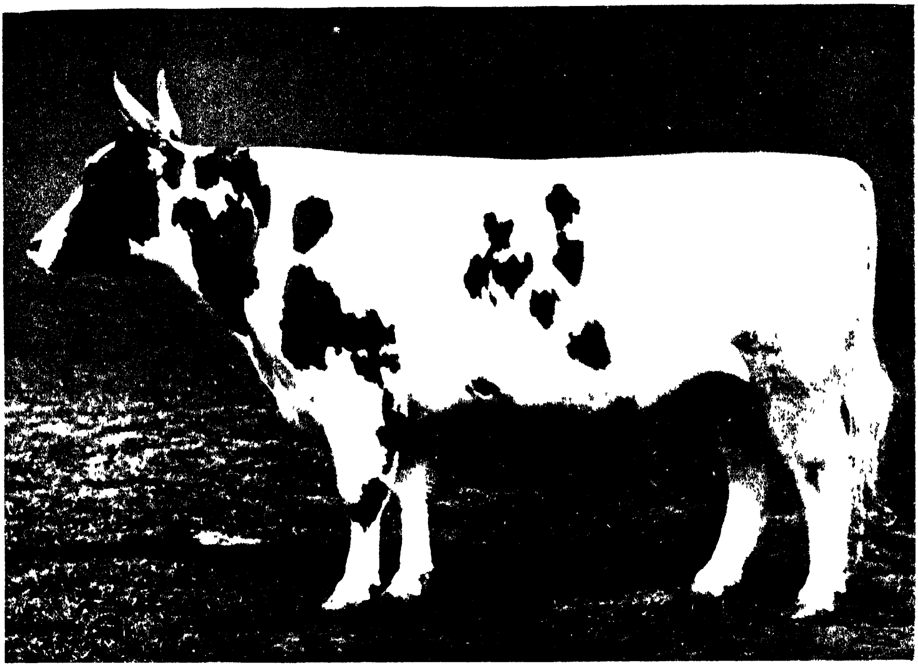


Photo C. Reid

AYRSHIRE BULL "SPICY SAM" (5027)

CHAMPION MALE, H. & A.S. SHOWS, 1906 AND 1907

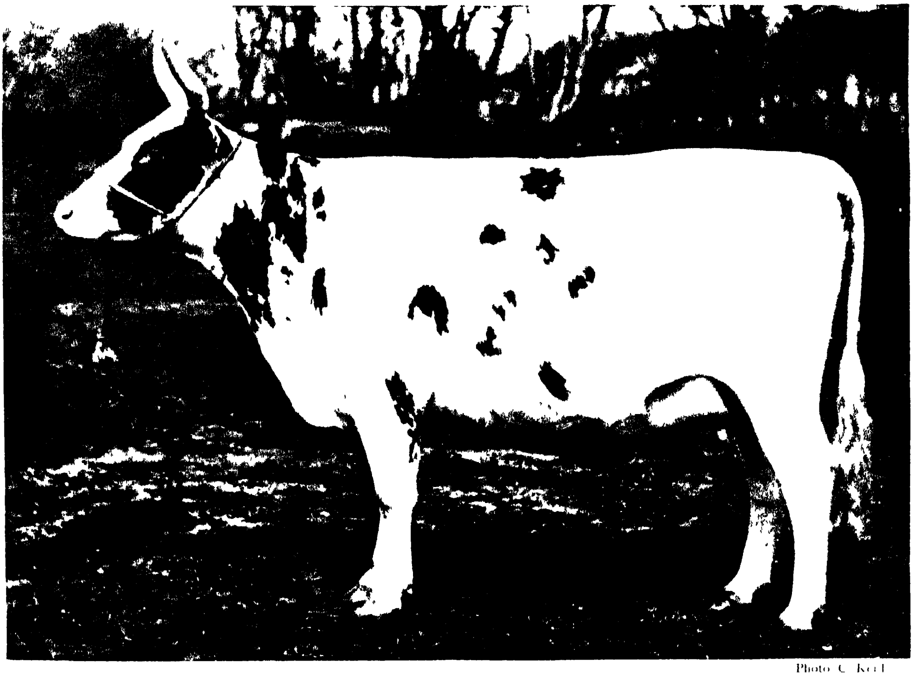


Photo C. Reid

AYRSHIRE COW "LADY MARY STUART" (10193)

FEMALE CHAMPION AT AYR SHOW, 1907

a previously existing native breed, but was an importation during the 17th century of red and white cattle from Holland. From the information at our disposal it is quite evident from the numbers which were available at certain dates, that they could not have been produced fron the few which the Earl of Marchmont is said to have imported in the first half of the 18th century. Had these animals been crossed with the native cows, which over a great part of the southern half of Scotland were at that date black, we know from Mendel's researches that the red and white colours would have been quite submerged in a very few generations by the dominant black. There are, and apparently always have been among Ayrshire cattle, a small proportion of black and whites, but among them the colour is rarely a mixture of black and brown or red, but a pure marbled black and white, similar to the Friesland cattle of the present day, where black takes the place of brown or red in what was probably the older breed. There being, therefore, little possibility of crossing the native cattle with the imported ones, and yet maintaining their colour characteristics, the probability is that the increase was mainly the result of pure breeding extending over a much longer period than is generally supposed.

THE MODERN DEVELOPMENT OF THE BREED.—Although the breed seems to have been well defined, and in almost universal use over Ayrshire, Renfrewshire, Lanarkshire, and part of Dumbarton, Stirling, and various other counties in Scotland between 1793 and 1794, the Ayrshire has since that time undergone considerable changes and improvements, largely as a result of the numerous annual shows and competitions held, and of the ideals thus formed in the minds of breeders.

The first premiums for Ayrshires were offered in Kyle in 1814 by the Highland Society, and the offer was renewed in 1816 and in 1821. While the Ayrshire as a breed had received no recognition at all in the Premium List of the Society from 1789, when its premium system began, till 1814, the rapidly growing extension and importance of the breed is shown by the fact that from 1822 onwards about half the premiums offered were for the Ayrshire breed. In 1826, at the first Highland Society show held in Glasgow, Ayrshire cattle were the chief feature, and one of the most successful exhibitors was the Duke of Montrose. At the same show in 1828, Ayrshires were again exhibited in great numbers; in 1830 there was a good turnout at the Highland Show in Dumfries, and in 1842 occurred the first numerous exhibit in Edinburgh. The report on the Highland Show held in Glasgow in 1850 contains the following criticism:—

'It is feared that the Ayrshire milking stock of late years has been bred to too light weights —a delicate appearance and a well-set udder being the points most aimed at. . . . The paramount object to be held in view in breeding Ayrshires is obviously to obtain the largest quantity of good milk, with a tendency to fatten when put up to be fed, and neither of these ends will be attained by light weights and delicacy of appearance.' This was about the date when the small teat and tight vessel craze began to come into fashion. A taste was also developed for up-turned horns, whereas the prevailing shape of horn in the older cows was generally in-curved. All three points had undue value put on them, and in course of time a cow of quite a different class began to be evolved.

In the history of the Ayrshire breed of cattle perhaps no single herd left such an impression on the breed generally as that of Drumlanrig belonging to the Duke of Buccleuch, and the dispersal of this herd in 1885 was an event of great importance to the breed, and created a record in prices which has not since been broken. The great prevalence of white colour in the Ayrshire of to-day, as compared with half a century ago, is in great part the result of the prominence which certain members of this herd attained in the show ring, and when they became dispersed over the country the impression left was even greater. This herd was selected with great care and skill, and included a large number of heavy milking cows, which had also taken high positions in the show yard for excellence of form.

For fifty years the great centre for the exhibition of Ayrshire cattle has been the April show of the Ayrshire Agricultural Association. The great centre of attraction is the Ayrshire Derby, which was instituted in 1872. This is a class for three-year-olds in calf or in milk, which have to be entered when a year old, and the winning cow holds the blue ribbon of the breed. The entries in this class at the show of 1907 numbered 66, and the total entries of male and female Ayrshires in the show amounted to 292 of all classes.

The next event of any great importance in connection with the breed was the inauguration of the Ayrshire Cattle Herd Book. This took place in 1877, rules and regulations for membership and entries being drawn up and approved of. Since then a volume of entries has been issued each year Its membership in 1907 stood at 53 life members and 265 annual members, and the entries of stock comprised 20,679 cows and 6769 bulls. On 19th February, 1884, and again on 10th July, 1906, the Society published scales of points to be used in judging the breed. These scales for cows were as given in the table on the next page.

A noted owner and judge of Ayrshire bulls, and late Secretary of the Renfrewshire Agricultural Society, Mr. William Bartlemore, made the following comment in 1889: 'It cannot be said that the scale of points formulated by that Society (Ayrshire Herd Book) is fully in consonance with the views of intelligent fanciers of the breed. That scale was adopted by those alone who had been following the showyard specimens of the breed—specimens which may all very well be perfection in themselves, but which experience has now demonstrated are in no way suited to the present commercial age. Where Ayrshire Cattle Show followers erred was in promoting a fashion of breeding for teats no bigger than a thimble, and neglecting the

SCALE OF POINTS FOR COWS

Description as given in Ayrshire Herd Book, 1884	1884. No. of points.	1906 No. of points.
1. Head short, forehead wide, nose fine between the muzzle and the eyes, muzzle large, eyes full and lively, horns wide set on, inclining upwards	10	8
2. Neck moderately long, and straight from the head to the top of the shoulder, free from loose skin on the under side, fine at its junction with the head, and enlarging symmetrically towards the shoulders	5	3
3. Fore quarters—Shoulders sloping, withers fine, chest sufficiently broad and deep to ensure constitution, brisket and whole fore quarters light, the cow gradually increasing in depth and width backwards	5	11
4. *Back short and straight, spine well defined, especially at the shoulders, short ribs arched, the body deep at the flanks*	10	13
5. Hind quarters long, broad, and straight; hook bones wide apart, and not overlaid with fat; thighs deep and broad; tail long, slender, and set on level with the back	8	11
6 Udder capacious and not fleshy, hinder part broad and firmly attached to the body, the sole nearly level, and extending well forward; milk veins about udder and abdomen well developed. The teats from 2 to 2½ in. in length, equal in thickness, the thickness being in proportion to the length, hanging perpendicularly; their distance apart at the sides should be equal to about one-third of the length of the vessel, and across to about one-half of the breadth	33	Udder 20 Teats 12 Mammary glands 5
7 Legs short in proportion to size, the bones fine and joints firm	3	
		Escutcheon 1
8 Skin soft and elastic, and covered with soft, close, woolly hair	5	6
9 Colour red of any shade, brown, or white, or a mixture of these, each colour being distinctly defined Brindle or black and white is not in favour	3	2
10 Average live weight in full milk about 10½ cwt	8	4
11. General appearance, including style and movement	10	4
Perfection	100	100

The ideal length of teat was stated in the scale of points of 1906 as from 2½ to 3½ in , and the live weight as from 800 lb. to 1000 lb at maturity. This is a great change in public opinion in thirty years, not only in the scale of points as drawn out by the Herd Book Committee, but more so in eighteen years in the live weight, as stated by Mr. Bartlemore, viz from 11 cwt. to 7½ to 9 cwt It is plain that Mr Bartlemore's ideal was largely in excess of the average Ayrshire.

yielding capabilities of the animal. Provided an animal showed perfection in these points, it mattered not how little she milked, and many first-prize animals were really inferior for dairy purposes.'

This blot on the Ayrshire breed was probably at its worst in the early seventies, but it is still too common. The fashionable size of teat among exhibitors of Ayrshire cows has slightly increased in length, but, notwithstanding some improvement, the small teat of the Ayrshire still remains a distinct defect.

The characteristics which should be possessed by good specimens of the breed have been so well expressed by Mr Bartlemore that they are reproduced here. 'The Ayrshire cow of the present day is a fully medium-sized beast, with wide upstanding horns, and body somewhat wedge-shaped. What breeders have universally aimed at in order to ensure the highest milking qualities is to produce an animal with body light before and heavy behind, with capacious, well-balanced udder. One main point, the calving bones, should not be wide. Animals of that class neither milk nor fatten well As regards the colour, it is much a matter of fancy. The prevailing one is flecked brown and white, but there are many splendid specimens all brown, while the leading showyard colour during the last ten years has been white, with brown or dark-brown sides of the head Few dairies in Scotland of any size at the present day are without their flecked black-and-white Ayrshire, and strange to say, that colour is much in demand by gentlemen who keep a few cows for family use. In any view, whatever is the colour, it should be well defined. One of the main characteristics of the Ayrshire cow is her extreme hardiness, her ability to exist and thrive in exposed situations on scanty fare and give a good milk yield While such is the case, however, she responds gratefully to more genial circumstances. Experience has shown that when taken to sunny climes she does as well as on her native pastures, and even better than any of the local breeds of cattle, provided always she get plenty of good water to drink, and is not pampered with too much good food, and receives that gentle treatment which she is accustomed to in the land of her birth. Wherever brought up, the Ayrshire should be kept well during the early part of its existence, so as to get bone and muscle, build up a healthy constitution, and beget beef. Unless the one- and two-year-old heifers are well treated they will never become properly developed, and remunerative to their owners. With a liberal diet at the outset, Ayrshires are sure to prove profitable, and add to their reputation in whatever part of the world chance may place them'

In the same year, 1889, Mr. A. Y. Allan, Munnoch, Dalry, directed attention to a question which forms the subject of much discussion among breeders of Ayrshires: 'We find one man year after year exhibiting very successfully yeld stock, while with cows he is nowhere to be found; and we find another man with milk stock always to the front, while his yeld are never seen. Now there is something wrong in all this, and herein lies one of the reasons why, in the showyard, Ayrshire cattle do not, as a rule, command respect amongst other exhibitors.' These are the carefully weighed expressions of opinion of a breeder and exhibitor whose family have been largely associated with the development of the Ayrshire, and the exportation of them during the whole of last century, and they focus the opinions of broad-minded men everywhere at the present day.

The Milk Yield of the Ayrshire.—The breed, like all milk-producing ones, varies enormously when the produce of one animal is compared with that of another, and on that account averages in many cases are apt to be misleading. Not only do cows of the same herd differ from each other, but one herd differs from another not only in its capability to produce milk, but in the quantity and quality of food which may be available for the production of milk. The Highland Society recognized this great difference of individual animals as early as 1829, for in that year they offered a premium for the best-managed dairy of not less than ten cows, details of which were to be given for a whole year. In the report by the convener it is stated that 'it was one important object with the Society to ascertain the difference in the quantity and quality of the produce of a given number of cows when the milk of each cow was manufactured separately, or when the aggregate quantity of the produce from the same cows was churned together.'

Where a herd receives careful attention, and sufficient food of a suitable kind to produce its maximum of butter, cheese, or milk, it may be considered good if the average is over 600 gal. of milk per annum. Many herds are over this, but there are others which are considerably under it. In the cheese-making districts 5 cwt. per cow has for a couple of generations been looked on as what a good herd on moderate land should produce. Where both the cows and the land are above the average more is expected, and where under less. In butter-making herds the equivalent is about 230 to 240 lb., as about 25 lb. of milk are necessary to produce 1 lb. of butter when the milk for the whole period of lactation is taken into account. For the year, the average butter fat in the milk usually runs from 3·5 to 3·75 per cent, but there are a considerable number of cows that go as low as 3·0 per cent, and even a few below it. There are quite a number of cows which have an average percentage of fat in their milk of 4·0, and a few which go as high as 4·25 and even 4·5 per cent.

Owing to the aim of some Ayrshire breeders being to produce animals to take prizes in the yeld classes, families have gradually been evolved which produce a small quantity of milk compared with the best specimens of the breed. Owing to their having taken prizes and to being entered in the Ayrshire Herd Book, breeders have often been induced to use bulls which had a very detrimental effect on the milk-producing powers of their progeny. During recent years there has, however, been a revulsion of feeling against stock of this class, and the introduction of milk-record associations conducted on the co-operative principle has done much to show the error of breeding from bulls out of such herds. Until these associations were started there was little authoritative information as to what was the actual yield of good specimens of the breed, as the average of all herds is always materially lowered by the small yield of some of the members of it. It is recorded that, early in the showing days, the late Mr. Wallace, Braehead, Ayr, exhibited a cow which gave 1305 gal. of milk in the year, and which had several extraordinarily large daily yields of milk. In many of the competitions which are annually held in various parts of the country, for the cow giving the greatest yield of milk, 60 lb. and over is not an unusual production in twenty-four hours, and a good many cows have yielded more.

The most profitable cow may, however, not be the one which has given an excessive yield of milk or butter in a limited period, but is usually the one which gives a fairly large but not excessive quantity for the greater part of her period of lactation. The milk records as conducted on the Ayrshire herds of Scotland during the last five years amply prove this, and as they have embraced something like 8500 cows in that time they may be considered reliable. Where the testing has been carried on for the whole year, or for the period of lactation of the greater part of the herd, about 2 per cent of the cows have a yield of 1000 gal. of milk or over. In 1905, in the parish of Fenwick, 18 herds, comprising 443 animals, had an average of 716 gal. of milk of 3·75 per cent of fat. Among these there were two cows, the total produce of which, on the basis of a morning and evening weighing and sampling of the milk over 21 days, was estimated to be 1312 gal. and 1305 gal. On the same basis there were several over 1100 gal., and a greater number over 1000 gal., one three-year-old heifer being among the latter. Besides having a large quantity of milk, these animals have nearly all a large percentage of fat in the milk, the average of the lowest being 3·5 per cent, while the most of the others range from 3·8 to 4·1 per cent. Such results as these clearly indicate the hidden possibilities which exist in the Ayrshire when sufficient care is exercised in the breeding.

Their Beef-producing Capabilities.—While the Ayrshire is the only native dairy breed of Scotland, and its principal qualifications are undoubtedly its hardihood and its production of milk, it is a very much better butcher's beast than is generally supposed. The principal reason why the public have an erroneous opinion of its value is that few of the male calves are castrated, and nearly all the heifers are utilized for dairy purposes, consequently few young animals of the Ayrshire breed are fattened, and what the public see are mostly cows. When, however, either bullocks or heifers are fed from birth with the object of selling them as fat animals, they not only feed well, but have flesh of a well-mixed class, which is never patchy, and there is seldom any difficulty in making them large enough. At the first Highland Society Show at Glasgow, in 1826, the Duke of Montrose exhibited two bullocks of the Ayrshire breed, four and a half and five and a half years old, which were sold for £120, notwithstanding the small prices then current for beef compared with now. While no one now keeps a fattening bullock till that age, no matter what the breed, yet it was common with all of them during the early years of last century. It is not claimed that the breed will fatten at the same rate as the principal beef breeds, but it is claimed that it will do so better than any other pure dairy breed, and that when young it makes quite a good butcher's beast.

THE HARDINESS OF THE BREED.—The hardiness of the Ayrshire is proverbial, although it would occasionally be to its interest were some of its members subjected to somewhat less rigorous conditions than those which it has now and again to put up with in the higher and more exposed parts of the country. If well attended to in regard to food and shelter during the first winter of their existence, it is wonderful how they struggle along afterwards under conditions which are anything but favourable. The most of breeders are inclined to stop giving the calves very much milk after cheese-making begins, and when artificial food is substituted they do not always continue it as long as they might. If fresh young pastures were always available this would not matter so much, but on many of the farms of the higher districts of Ayrshire, Renfrewshire, Lanarkshire, &c., there is generally very little young fresh grass, and there the calves have to get along as best they can with what is older, and what can be got from the meadows after the hay is in. During the first winter the bulk of their food is hay, often of very middling quality, with a run on the hills during the day. The following summer many of them are on exposed hills all the time from 15th May, and where there is fairly dry ground and some shelter from hedges or plantations, many of them are wintered outside during their second winter. The bulk of them, as a rule, drop their first calf when three years old, but the stronger ones among them, and those having a tendency to be coarse, are often timed to calf at two and a half years old.

The average prices realized by the breed are very moderate when compared with other pure breeds. In the spring the average cow, four to six years old at the calving, will sell at from £16 to £18, and in the autumn the same cow at calving would probably bring from £1 to £2 more. Good specimens of even commercial Ayrshires will give several pounds over these prices, and if they are eligible or entered in the Herd Book £2 or £3 more will have to be added. Cows capable of taking a position at any local or county show will give about 50 per cent above ordinary commercial value. If they have good milk records, or have taken leading prizes at open shows, their value will be grown two to three times that of ordinary commercial animals. Much the same applies to bulls. Fair average yearling bulls can be purchased at from £15 to £20, but if from special animals the value will be from £20 to £30, and superior animals considerably more. The chief markets for Ayrshires are Ayr, Paisley, Stirling, Dumfries, Castle Douglas, and Stranraer.

The breed is now more or less spread over every county in Scotland, and exists in considerable numbers even in England. In the south-western counties of Scotland no other dairy breed is of any importance. There are great numbers in Canada, United States, Australia, New Zealand, and Japan, and quite recently considerable numbers have been sent to the hill districts of India. Of foreign countries, Sweden and Finland and Canada have been the largest importers. Norway has also received a considerable number, but hitherto the bulk have gone there via Sweden. Where put to the use for which it seems eminently adapted by nature and constitution, viz. the production of good milk from indifferent herbage, it has invariably given a good account of itself, as it can exist and do well where heavier breeds can scarcely live. It seems to have the power of speedily adapting itself to its surroundings, be they those of 'Greenland's icy mountains' or 'India's coral strand'; and judging from present appearances the Ayrshire bids fair to be the chief dairy breed of the world in the not very distant future.

[J. S.]

Azalea.—Although botanically all the azaleas are now included in the genus Rhododendron, for garden purposes it is better that they should be distinguished by the name which was given to certain plants that came from North America and China, and are popularly known as Ghent or Mollis Azaleas or Swamp Honeysuckles. These plants are all hardy, but they are apt to be spoiled when in flower by late spring frosts, as they come into bloom in May. They are not nearly so generally grown outside as they deserve to be. There are fine displays

Azalea mollis

of them annually in the Royal Gardens, Kew, where for at least half a century a large collection has occupied a considerable area sheltered by surrounding large trees. They require a light loamy or peaty soil, and they object to all soils containing lime or chalk. They are largely grown in Belgium and Holland for the English and American markets, and it is possible to obtain good bushes of them at a very cheap rate. They transplant freely, and they are most profuse flowerers, the whole bush being almost, if not quite, hidden by the flowers, which usually come before the leaves The colours of these azaleas are all beautiful; no harsh or vulgar shade can be found among the hundreds of variations of colour and form Some have large honeysuckle-like clusters of flowers, whilst others are bell-shaped, and arranged in compact heads A typical variety of the Mollis section, and one of the best, is Anthony Koster, whilst the Ghent or Swamp Honeysuckle section is represented by Flambeaux, a brilliant red. It is not, however, necessary to get named sorts, the seedling varieties are all beautiful, and the majority of the growers do not trouble to name them. [W. W.]

Azote. The French chemist Lavoisier applied the name 'azote' to nitrogen gas to denote its inability to support life (Greek, *a*, not, *zōē*, life) Although formerly much used in books of agricultural chemistry, it has now been superseded by the term 'nitrogen' See NITROGEN.

Azoturia, or Hæmoglobinuria of Horses.—This disease is believed to be due to a nerve toxine, and invariably occurs in horses which have had a period of idleness in the stable while in receipt of a working or full ration. When put to work, the malady suddenly displays itself soon after starting The animal falls lame behind, breaking out into a sweat, blowing, and showing signs of acute pain and alarm; so much so as to induce the belief that a broken leg has brought about a failure so sudden in an animal apparently in robust health but a few minutes previously. The urine next passed will be charged with albumen, and highly coloured from the presence of suspended granular pigment from extravasated blood in the voluntary muscles, which are thrown into violent spasm. These muscles are found after death to be pallid, and in various organs of the body are to be discovered the crystalline pigment referred to.

Treatment consists in prompt bleeding from a large vein, as the jugular, removal to nearest stable, an aloetic purge, followed by salines of a laxative character, enemata to promote the effects of the laxative medicines, or hypodermic injections of physostigmine. To control spasm, give chloral hydrate, opium, cannabis indicus, sodium or potassium bromide, or nitrous ether. Turpentine, as spirit, in linseed oil, is much favoured by practitioners, and appears to have the effect of an antitoxine, preserving the blood from decomposition by holding together the red corpuscles. Turpentine is also advised as a liniment, combined with ammonia, and any bland oil, and applied to the loins. The disposition to heart failure, which in some cases causes death, may be combated by frequent doses of alcohol in its popular forms, or ether, ammonia, or sweet spirit of nitre Quinine in dilute sulphuric acid, as a tonic and restorative, is advised when the first acute symptoms have passed off. It may be necessary to give the support of slings for a few days, and the urine must be regularly drawn by the catheter if the animal is unable to pass it. *Prevention.*—Regular work, or exercise when not required to work, lowered diet, and occasional purges. More or less permanent lameness often results from an attack. [H. L.]

B

Baby Beef.—The term 'baby beef' is used to describe fat cattle which are sold to the butcher below the average age at which animals of the breed are generally ready for slaughter In this country any animal sold fat under eighteen months old, except a veal calf, may be considered baby beef, and the usual age will be from fourteen to eighteen months. In America classes are provided in fat-stock shows for fat animals under one year old, and it is possible that the term may have come from that side of the Atlantic, but it has been in use among British breeders and feeders for at least fifty years

Ever since the Brothers Colling commenced the improvement of the Shorthorn, the length of time required by cattle of the beef breeds to reach maturity, as represented by fitness for slaughter, has gradually shortened. In 1779 the famous Blackwell ox, at the age of six years, yielded a butcher's carcass of more than a ton weight, and this ox was considered a model of a butcher's beast. Since then, the figures supplied by the records of the Smithfield Club clearly indicate the gradual decline in slaughtering age of the best specimens of fat cattle, a decline which culminates in America with what is literally baby beef derived from stock under a year old.

In 1808 the best ox in six classes at Smithfield was over six years old, in 1838 the best ox in any class was four years and eight months, in 1868 four years and three months, and in 1898 two years and eleven months. Since 1898 several of the champions at Smithfield have been younger than that. The Smithfield Club for many years has offered prizes for fat cattle under two years of age, and as the example of the premier fat-stock club has been followed by all or nearly all other similar associations in the country, great encouragement has been offered for the rapid fattening of immature animals.

The supply of baby beef has arisen partly through the demand for smaller joints by people of small establishment who formerly could not, but now can, afford a frequent diet of butcher meat; partly through the desire of the farmer to obtain a quicker cash return, and partly from an extension of the knowledge that increased live weight is more economically obtained when the animal is young. Ordinary wellbred cattle will increase in live weight at the rate of over 2 lb. per day during the first year, about 1¾ lb. the second year, and still less in the third year.

Calves in the Chicago Fat-Stock Exhibition killed when 330 to 335 days old, showed a daily gain of 2·8 to 2·9 lb., including the weight of the calf at birth, which may be taken as 75 or 80 lb.

To take full advantage of the first year's growth, the stock must be well bred and the feeding must be liberal. The feeders of baby beef are not always the breeders. In many cases the stock are bought as calves, and Shorthorn-Galloway crosses or 'blue greys' which have been suckled by their mothers are favourites for high feeding in the south of Scotland and the north of England. In the north-east of Scotland, black polled calves of nearly pure Aberdeen-Angus blood are common. Pail-fed calves from the dairying districts and from Ireland are also used, but the tops only are finished under eighteen months old. Purchases are made in autumn or early winter, the 'blue greys' being then about six months old, and the black polls a month or two older. The former may be fed off on the early grass of the following year with a ration of cake, but the latter are generally sold from the stalls or courts in early summer. Most feeders of young stock bought as calves do not succeed in making all their stores into baby beef, but dispose of the tops in spring, and keep the backward ones over the grass season, gradually selling off those that are fat. The farmer who purchases calves for quick feeding is never sure of making baby beef, as the quality of his stores may vary from season to season. Greater success in this line is obtained by the feeder who is also the breeder, or at least the rearer of the calves. Calves for quick feeding are generally suckled, sometimes two or even three to each cow, the third being put to the cow when the first two are weaned. If the object is to finish at fourteen or sixteen months old and to fit the animal for showing, each cow rears only one calf, and the calf is taught to eat cake or meal before it is finally weaned. After weaning, a ration of yellow turnips or cabbages, preferably the latter, is given along with hay or straw, or both, and the stock have the run of a court, partly or completely covered according to the climate. The concentrated food consists of cakes or meals; the safest and most popular single food is linseed cake, which is fed at the rate of 2 to 4 lb. in two meals. The most successful feeders either pulp the turnips or cut them into finger pieces, and invariably chaff most of the straw or hay. Mr. Ross of Millcraig, whose successes at Smithfield entitle him to a first place among feeders of baby beef, makes a practice of steaming the chaffed hay and straw, and gives nearly all the food in the form of a mash.

Whatever the ration may be, it is gradually increased throughout the winter, the hay and straw being replaced in the spring by rye grass, clover, and vetches, when these become available. With good material to work upon, and sufficient skill and experience, not more than 6 or 7 lb. of cake or corn will be necessary even at the finish. By such a system cattle fit to kill at ten months old can be produced, though they are generally kept for some months longer.

The production of baby beef is only excusable for exhibition, or on the grounds of the profits realized, for there is no doubt that it is inferior in quality as compared with the more mature beef which has been laid on more naturally at from two to three years old. A wellbred 'blue grey' or Aberdeen-Angus calf that has not been unduly forced will provide the best quality of baby beef, which, however, will be inferior to that of the same breed killed at a greater age. The fat but immature animal yields a larger percentage of offal, a greater proportion of fat to lean, more watery flesh and flesh of less delicate flavour, than is obtained from the full-grown bullock or heifer. [R. B. G.]

Baby-feeding, Milk for. See INFANTS, MILK FOR.

Baby Separator. See SEPARATORS.

Bacillus, a species of bacterium. See BACTERIA.

Back.—Reference to the 'back' of an animal does not in the horseman's phraseology imply the whole length of his spine from the nape of the neck to the buttocks, as would be understood in speaking of his master, but includes the parts which are bounded by the end of the withers and top of the rump or croup, and on either side as far as the lateral spinous processes extend. A good 'back' refers chiefly to the loins of a horse, but in describing a bullock with a back 'as straight as a gun-barrel' a longer view is taken, and includes the withers. The same may be said of sheep and pigs or other animals destined for food, since there is a conformation recognized, as carrying most valuable meat, in which a straight back is an essential feature. [H. L.]

Backband.—The backband is that portion of horse harness which runs through the pad or harness saddle, and to which the tugs are attached by buckles. Its continuation passes under the belly and is called the belly band. See HARNESS. [H. L.]

Backing.—This term has many uses, as will be seen by reference to a standard dictionary, but in connection with animals employed in labour is understood to mean a movement to the rear, and usually executed by the control of the bit or other contrivance by which draught animals are made to obey man's behests. An unruly horse may back of his own accord and in disobedience to his master, when he becomes extremely dangerous if attached to a vehicle. Backing is taught by horse breakers. See BREAKING. [H. L.]

Backstein Cheese.—The predominant type of cheese in several of the great dairying countries comprising the south-western section of continental Europe is commonly designated by the generic term 'soft cheese'. There is, however, another type—a type we are most of all familiar with in England—and it is sufficiently differentiated for practical purposes by the term 'hard cheese', also generic in its application. It is to this type, which is a good deal varied in its manifestations, that Backstein cheese is understood to belong.

The late Dr. H. L. de Klenze, a recognized authority on continental dairying in the last quarter of the 19th century, apparently claims the Backstein variety as a Bavarian cheese, though he admits it is an adaptation of the better-known Limburg cheese of Belgium It is a variety, no doubt, that resembles the Limburg, though to prove it an adaptation might be found a difficult point; and this because there are various spontaneous and undesigned coincidences in the domain of dairying, as elsewhere in the realm of industrial evolution. As amongst soft cheese, so amongst hard, there are relatively few that possess—as Gruyère does, and Roquefort, and Parmesan on the Continent, and as Cheshire, Cheddar, and Stilton do in England—a really distinct and striking individuality of their own. Backstein is not one of these; it is a member of a family, showing a family likeness that is more or less unattractive.

Backstein cheese is generally made of skim milk; and therefore it can only at best be regarded as an inferior dairy product, a poor relation of the family to which it is allied. It is an undeniable axiom that cheese made from skim milk is necessarily an inferior article. But it affords a way of putting to a useful purpose a by-product of buttermaking, and it forms at once a cheap and nutritive as well as a wholesome article of food—in moderation—for people whose means demand economy in expenditure. The method of making it differs more or less, here and there, and the result depends on individual skill and on circumstances. [J. P. S]

Bacon, Chemistry of.—The flesh of the pig contains a large proportion of fat, and is therefore difficult to digest compared with beef. Moreover, this fat consists of palmitin and olein, with little or no stearin; it is therefore soft and buttery, in this respect resembling human fat, which contains from 67 to 80 per cent of olein. Of all the forms of pig's flesh, salted pork seems least digestible, taking as much as 5 hours in the stomach, according to Beaumont, while roast pork takes 4 hours, boiled ham 3, and bacon is the most digestible form of all. In fattened pigs, from 80 to 85 per cent of the life weight is meat with bone, and on an average from 75 to 80 per cent is available for food. The following analyses give comparative figures with reference to various cuts and preparations of pork.—

	Refuse	Water	Proteids	Fat	Ash
Ham, roast, medium fat; average of 3 samples	3·44	57·86	22·26	15·97	1·16
Ham, roast, fat; 4 samples	3·73	54·84	20·64	20·41	1·03
Shoulder steak, fat, 3 samples	6·64	53·03	15·48	24·57	0·79
Ham, sugar-cured	4·46	33·18	21·91	33·31	5·60
Bacon; 4 samples	6·18	20·92	8·02	61·34	3·78
Lard	—		—	99·95	0·05

Rejecting *the refuse in the above, the analysis* of the edible portion works out as *follows:*—

	Water.	Proteids	Fat.	Ash
Ham, roast, medium fat	59·94	22·92	16·67	1·19
Ham, roast, fat	56·96	21·32	21·34	1·06
Shoulder steak, fat	56·97	16·57	26·39	0·85
Ham, sugar-cured	34·72	22·93	34·87	5·86
Bacon	22·28	8·57	65·42	4·02
Lard	—	—	99·95	0·05

The great differences in quality and methods of curing are shown in the following American analyses of bacon alone:—

	Refuse	Water	Proteids	Fat	Ash.
Bacon, smoked, lean, as purchased	9·6 to 24·4	23·3 to 29·6	10·1 to 15·9	30·2 to 40·8	5·1 to 12·3
Bacon, edible portion	—	30·8 to 32·7	13·4 to 17·6	40·0 to 45·2	5·7 to 16·3
Bacon, smoked, medium fat, as purchased	2·9 to 13·0	7·1 to 24·8	5·7 to 15·7	52·7 to 72·8	2·4 to 7·2
Bacon, edible portion	—	7·7 to 26·9	6·3 to 18·0	57·4 to 79·7	2·7 to 7·9

[J. K.]

Bacon-curing.—The object of curing bacon is to preserve the meat from decay, and this is done both positively and negatively, by removing, as far as possible, those substances, like blood, which are most putrescible, and by adding at the same time other substances which have an antiseptic or germ-killing power. As germs of putrefaction cannot flourish in the absence of water, it would be a simple solution of the problem to desiccate the meat by exposure to a current of hot, dry air, as in the preparation of 'biltong' and 'pemmican', and such a method would be admirably adapted for flitches, which present a large surface in proportion to their mass. To a certain extent this method is implied in 'smoking', although here the process is not independent, but follows some form of cure, wet or dry, and, moreover, is further helped by the antiseptic action of the smoke products themselves.

Another principle has been borrowed from wood-preserving. In this case a suitable pickle is mixed, but the meat is first of all treated in a closed chamber under a vacuum pump, in order to extract all the air from its pores. When the exhaustion has proceeded for an hour at a pressure of 28 in. (atmospheric pressure = 30 in.), the brine is allowed to rush in and replace the exhausted air. This it does very completely in about four to five hours; the unused pickle is returned to the brine vat, and may be used over and over again, while the process is so expeditious that pigs may be killed one day, pickled the next, and packed and despatched on the third. It, however, demands factory appliances, such as a vacuum pan and steam engine, and so has not come into general use, though shown so far back as the Exhibition of

1861. In view, however, of the success of this method in creosoting timber of even close grain, and in the injection of such preservatives as copper sulphate and corrosive sublimate in solution, it is worthy of a more elaborate trial.

Practically the method of curing takes the form of saturating the meat with a brine or pickle. In farms, and generally on the small scale, it is sufficient to steep the meat in a solution of the required strength, but on the large scale this is preceded by the free use of a syringe, in order to impregnate the meat more thoroughly. The common pickle used is 55 lb. of salt, 5 lb. of saltpetre, 5 lb. of dry antiseptic, such as boracic acid, sulphite of soda, sodium fluoride, or other non-poisonous germicide, and, in winter only, 5 lb of cane sugar, the whole made up to 20 gal. with water. As a gallon of pure water weighs 10 lb., this means the addition of 13 gal, and gives a brine showing a strength of salt 27½, saltpetre, antiseptic, and sugar 2½ each per cent. The sugar is kept back in summer, owing to the ease with which it promotes fermentation in hot weather. The saltpetre has only a weak germicidal action, its real use being to freshen the colour of the meat. The action of the antiseptic used is obvious, killing any germs of putrefaction already present, and rendering the meat sterile for any subsequently arriving from without, a defensive operation helped by the various subsidiary processes for treating the surface of the pickled meat. The main principle, however, underlying the whole process of wet curing is that of osmosis, or diffusion of liquids through animal membranes. A double current is established, of the animal juices outward and of the brine inward, and this, if unchecked, would continue until both inner and outer liquids were of the same density. Unfortunately, a good deal of meat consists of substances which are soluble either in water or in salt solutions, and not only are these lost in the brine, but by the action of the pickle itself the remaining constituents of the meat are rendered harder and less digestible, consisting as they do of insoluble fibrinoids, and being further impregnated with saltpetre and other substances which have, in excess at least, a retarding effect upon the digestive juices. Liebig estimated the loss in this way at as much as one-third or even one-half of the fresh meat, so that the process of curing has been described as destroying a certain proportion of the meat in order to preserve the remainder, even though this be rendered more indigestible. The question of flavour of course arises here, and although the taste for cured and smoked bacon is undoubtedly acquired, still the particular 'tang' imparted by these processes acts as a condiment, and thus to a certain extent makes up for the undoubted loss in digestibility. Smoked ham, for example, is notoriously difficult of digestion, and yet many physicians, and especially Niemeyer, have noticed that some dyspeptics can digest salt and smoked meats better than fresh. The explanation generally given is that these meats are less readily decomposed, and do not give rise to acid fermentation in the stomach. (See on this subject Burney Yeo's Food in Health and Disease, Part II, ch. ii.)

The accessories of bacon-curing include the killing of the animal in such a way as to drain off the blood most thoroughly. After being killed and bled, the carcass is scalded for not less than five minutes at a temperature slightly under the coagulating point of flesh, 180° F. Scalding facilitates removal of the hairs, which with surface scales are scraped off; then the surface is singed in order to harden the rind and fat and impart a peculiar roast flavour to the meat, besides rendering the skin more resistant to the solvent action of the pickle. Many curers singe the carcasses before removing the hair, pigs for Wiltshire bacon are not scalded, but elsewhere the practice is universal. After scalding, the carcass is cooled, cleared of offal, then washed clean, and chilled at a temperature not higher than 38° F. Curing is carried on in a moist atmosphere at a temperature of 40° to 42° F. The pickle is injected by means of a syringe holding from 6 to 8 oz. of the liquid, and is pumped in at a pressure of 40 lb. to the square inch, through from ten to fourteen punctures according to the mass of the meat. The sides of bacon are laid rind downward, covered with a mixture of antiseptic and fine saltpetre, with a heavy layer of salt on top, so that each side forms practically a shallow basin, storing the pickling products. The time of curing depends upon the kind of ham wanted and the time of consumption. Roughly speaking, one day to the lb is reckoned for immediate use, and two days to the lb. when a 'bloom' is demanded, the 'bloom' in question being due to the presence of fungi (Penicillium), which are supposed to mark a high standard! For a mild cure 14 lb of meat take 15 days, for a 'keeping ham' 21 days, and for Yorkshire ham 30 days. The mild Irish hams which figure on the Continent as 'Jambon de York' run about 12 lb; Yorkshire hams are heavier, 30 to 50 lb., and are very salt; while Suffolk hams, though very small, are cured till they are almost black; and similar differences are observed in bacon, some German varieties being so highly cured as to be eaten uncooked. When the cure is completed, the bacon is 'struck', drained, washed, trimmed, and sent off.

When bacon is to be smoked it is first mild-cured as before, then after being trimmed as usual it is dusted with pease meal and smoked for three days at a temperature of 85° F.; the smoke is generally obtained from oak sawdust. Sometimes hams are pickled to secure special flavours, and naturally the recipes are as numerous as the tastes. The following is given as a pickle for one ham. Take 1 lb salt, ½ oz. saltpetre, and 2 oz sugar, rub well into the ham, and lay this in a water-tight cask. Make up a pickle by boiling in ½ gal of water, 1 lb. salt, 2 oz juniper berries, ½ oz pepper, ½ oz cloves all whole. When cold, pour this over the ham, adding a small quantity of garlic if desired, then allow the ham to soak for three weeks. Then remove it, wash, hang for eight days in the open air, then smoke for other three weeks for a keeping ham, for immediate use three days' smoking will be sufficient. [J. K.]

Bacon-curing (Scotch Method).—

The common methods of preserving bacon in Scotland are by drysalting and by pickling—the former being the general rule where a small quantity is treated at one time, and the latter is customary for larger or trade requirements. In the drysalting process for private use, a pig not exceeding 1½ cwt. is to be preferred to one of greater weight, since the desire for heavy, fat bacon no longer exists. This may be preserved in the Ayrshire style of rolled bacon by cutting the carcass into four quarters, after having removed the head, feet, kidneys, and lard. The bones from the four quarters, including the shoulder blade, are taken out. The fore legs are cut off close up to the side, and the shank bones are removed from the hind legs by making a horizontal cut at half the thickness of the ham without completely severing the piece so cut. The shank bone being laid bare, it can now be removed along with the shank In preserving for private use, the quarters are first labelled 1, 2, 3, and 4. Two oz. of saltpetre are then sprinkled on each quarter, and from 3 to 4 lb. of salt are applied, taking care to put a sufficient quantity in the pocket caused by the removal of the shoulder blade. They are then piled one upon another and left for periods varying from ten to twenty days, after which they may be rolled with twine, and placed in muslin bags and kept in a cool place. By numbering the quarters and varying the duration of salting, varying degrees of mildness or saltness are ensured, corresponding to the length of time it is desired to keep the bacon

The smoking of hams is usually done in a smoke-tight compartment specially constructed for the purpose, wheat or barley straw and hardwood sawdust being ignited underneath the hams, suspended not less than 8 ft above a stone floor.

In the preparation of flitch bacon the same procedure is adopted, with the exception that in this case the shanks (with the lower part of the legs and feet removed) may be left upon the sides if desired. Sides not exceeding 60 lb. weight each may receive 4 oz. saltpetre and 4 lb. salt. They are thereafter piled on each other in a cool place for periods varying from ten to twenty days, according to the state of the weather or according to the degree of saltness desired. Each side is numbered as before mentioned, so that the milder-cured sides may be used first.

Hams not exceeding 20 lb. weight may be given 1 oz. saltpetre and 1 lb. salt, firmly rubbed in on the fleshy surface. The operation is repeated in ten days, and the hams are then allowed to remain for a further ten days

In large bacon-curing establishments, preserving by 'pickling' is the usual mode, the strength of the pickle being ascertained by means of the hydrometer and regulated according to the trade requirements. [T. H S.]

Bacteria, Bacteriology.—Amongst the many subjects of interest to the agriculturist there is probably at present none of greater importance than the application of bacteriology, the most recent of biological sciences, to the oldest pursuit of the human race, or possessed of such far-reaching possibilities. It is little more than a couple of decades since scientists first began to realize the important part played by bacteria in aiding the growth of plants; yet so rapid has been the progress of discovery in this subject, that a distinct branch of science known as agricultural bacteriology has arisen.

In the ordinary acceptation, bacteria are usually associated with disease. Whilst many bacteria are disease-producing, by far the greater number are not only harmless, but it is now generally recognized that they are essential for the continuance of life on the earth.

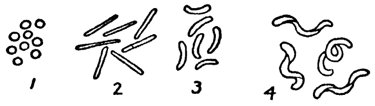


Fig 1 —Forms of Bacterial Cells

1, Coccus, 2, Bacillus, 3, Vibrio, 4, Spirillum

Although bacteria were first figured and described by Leeuwenhoek, the Dutch microscopist, in the 17th century, it was not until the work of Pasteur demonstrated the importance of these organisms that attention was directed to them and they were studied scientifically.

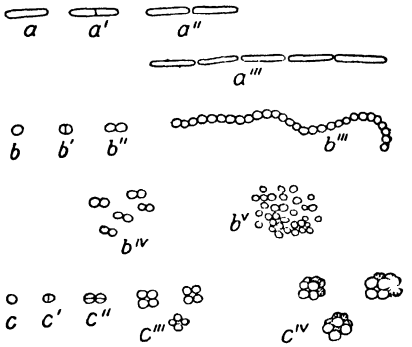


Fig 2 —Diagrammatic Representation of the Methods of Vegetative Reproduction among Common Bacteria

a, A bacillus successively dividing at a^{I}, a^{II}, and a^{III} *b*, A coccus giving rise to chains, b^{III} (*Streptococci*), pairs, b^{IV} (*Diplococci*), and irregular groups, b^{V} (*Staphylococci*) *c*, A coccus giving rise by division in two directions to c^{III} (*Micrococci*), and by division in three direction to c^{IV} (*Sarcinæ*).

At first they were considered to be animals, owing to their motility, and were classed with the Infusoria. Later investigation, however, showed that by their structure and mode of growth they are more nearly related to the vegetable kingdom, and they are now recognized as microscopic colourless plants. They belong to the large group of Fungi, and owing to their peculiar mode of division are known as fission-fungi or *Schizomycetes*.

Bacteria have a very simple structure—a speck of living protoplasm surrounded by a capsule or cell wall. They are unicellular, and are the smallest living organisms known, some being less than $\frac{1}{25000}$ in. in diameter. Although there are hundreds of different species, there are only three general forms — the spherical (termed a *coccus*), the rod-shaped (termed a *bacillus*), and the spiral (termed a *spirillum*). A curved rod is termed a *vibrio*. The term 'bacterium' is sometimes employed to denote a short bacillus, but it is also used as a general term for any organism of this group Many are motile, moving by means of slender hairs known as *flagella* or *cilia*

The common method of reproduction is by simple division or fission. Each individual divides into two similar halves, each of which grows to the original size and again repeats the process Under certain unfavourable conditions of growth the contents of the bacterial cell collect into one or more rounded masses known as *spores* In this condition they are able to resist adverse conditions They may be dried for months, or even years, without losing their vitality. Some in this condition may be heated to a temperature above boiling-point without being killed It is this resistant stage of bacteria which is of such great importance in connection with disinfection

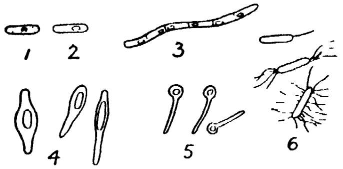


Fig 3 —1, Bacterium showing beginning of Spore Formation completed in 2 3 Chain of Bacterial Cells in each of which Spores have been produced 4, Forms of Clostridium Cells with Spores 5, Drumstick shaped Bacteria with Spores at one end 6, Bacteria with Cilia

One of the most important facts connected with the life of bacteria is the rapidity of their multiplication. A single bacterium dividing into two, and taking one hour for the completion of the process, will in twenty-four hours produce 16,000,000 For this multiplication suitable food is necessary As they consume this food material they produce chemical changes in it, absorbing their own food particles, and leaving behind decomposition products or cleavage products These products vary, of course, with the different species of bacteria producing the change. In some the product is odoriferous, causing the foul smell associated with organic matter 'going bad'; in others it may be a flavouring substance, as in game, butter, cheese, tobacco, &c.; whilst the products of disease bacteria are of a poisonous nature, and known as toxins.

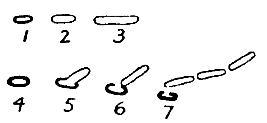


Fig 4 1, 2, and 3, Diagrammatic Representation of the Successive Stages of Germination of a Bacterium Spore 4, 5, 6, and 7, Another Common Method of Germination of a Bacterium Spore

Of all the chemical changes produced by bacteria, none are fundamentally more important than those due to the activities of the bacteria present in the soil. The farmer's life is intimately associated with bacteria, and upon them he depends for the fertility of his soil and the production of his crops.

In ordinary cultivated soil the number of bacteria varies from 300,000 to 10,000,000 per gram of dry soil. They occur in greatest number in the first 6 in of the soil, below this they rapidly diminish, until at a depth of about 3 ft very few are to be found. The significance of a number of these organisms is not yet clearly understood, but the majority are essential for a proper maintenance of soil fertility, and without them the world would soon become a barren waste Speaking generally, they may be classed into three groups (1) The decomposition bacteria, (2) the nitrifying bacteria, (3) the nitrogen-fixing bacteria

1 The Decomposition Bacteria — These bring about the decay of organic matter in the soil, resulting in the production of the dark material known as humus This process of decay is not a simple one, but takes place in several stages In the rotting of manure, for example, the substances which make up the manure lose their structure and become altered and unrecognizable, and a large proportion of the organic matter becomes soluble. The decomposition of cellulose or vegetable fibre is due to the fermentation action set up by various kinds of bacteria These organisms secrete a ferment or enzyme known as *cytase*, which converts the cellulose into some form of sugar As there are various kinds of cellulose in the cell walls of plants, they do not undergo dissolution equally Hence, when vegetable fibre undergoes decomposition in the soil, some parts are more rapidly dissolved than others, and the product of this incomplete decomposition forms the chief bulk of humus

In the decomposition of proteid matter the first step is the conversion of insoluble proteids into soluble peptones This is brought about by the ability of certain bacteria to secrete an enzyme called *trypsin* These liquefying or peptonizing bacteria are present in abundance in all soils, and, when conditions are favourable, rapidly liquefy the proteid matter. The next step in the process is the conversion of the peptones into amido bodies; and finally these are reduced by other bacteria to ammonia, organic acids, and free nitrogen. This ammonia and nitrogen, if set free from the soil, would be lost to agriculture, but fortunately at this stage other soil bacteria take up the work and fix these substances.

2. The Nitrifying Bacteria. — In 1871-5 Sir J. H. Gilbert showed that the drainage waters from the experimental fields of Rothamsted contained more nitrates as the amount of ammonia salts applied to the land was increased, and suggested that this nitrification, as it is called, was due to micro-organisms. In 1890-1

Winogradsky and Warrington demonstrated that nitrification was effected by two distinct organisms, the one —*Nitrosomonas*— converting ammonia into nitrous acid and nitrite; the other —*Nitrobacter*— changing the nitrites into nitrates. These nitrifying organisms are what are technically known as aerobic, that is, they grow only in the presence of atmospheric air. Hence one among other reasons why cultivation of soil is beneficial is the fact that it aids nitrification by bringing the oxygen of the air into more immediate contact with the nitrifying bacteria.

3 THE NITROGEN-FIXING BACTERIA.—The dissipation of free nitrogen into the air is going on wherever putrefaction takes place, and thus the total amount of nitrogen food available for plants is constantly diminishing, for plants can only absorb their nitrogen in a combined form. Here again bacteria come to the aid of the agriculturist, and reclaim for him a varying amount of this free nitrogen from the air. From the earliest times it has been recognized that the growing of leguminous crops had a beneficial effect upon the soil. The meaning of this was not understood until 1886, when Hellriegel demonstrated that these plants somehow obtain their nitrogen from the air, and their growth in soil free from nitrogen compounds depends on the presence of the nodules on their roots. Shortly afterwards Beijerinck showed that these nodules contain bacteria which have the power of fixing free nitrogen and rendering it available for the plant. This fixation of nitrogen not only benefits the plant possessing the nodules, but also increases the nitrogen store of the soil, for when the leguminous crop is harvested the nodules remain in the ground and yield their nitrogen contents to the succeeding crop, thus explaining the importance of including some leguminous crop in the ordinary rotation of crops. These nodule-forming and nitrogen-fixing bacteria are normally present in most soils in varying numbers. Recently much interest has been aroused in the possibility of increasing the number of nodules on the roots of leguminous plants by applying to the soil pure cultures of these nitrogen-fixing bacteria, and thus increasing the yield of the crop. This method of 'soil-inoculation', as it is unfortunately called, has proved most beneficial on many soils low in organic matter, and, when the conditions for successful inoculation are better understood, promises to be of great importance to agriculture.

In addition to the nitrogen-fixers growing in association with leguminous plants, there are numbers of other bacteria living in the soil which possess the power of fixing atmospheric nitrogen. The most important of these are the members of the Azotobacter group discovered by Beijerinck in 1901. If further research should confirm the results of laboratory experiments with these various nitrogen fixers, the utilization of a practically inexhaustible source of the most expensive element of plant food will be rendered possible.

In addition to their importance in maintaining soil fertility, bacteria are active agents in the dairy industry. Modern dairying consists largely in trying to prevent the growth of bacteria in milk, and promoting the growth of special kinds in cream, butter, and cheese.

Milk forms an ideal food for bacteria, and they multiply in it with great rapidity. A cubic inch of market milk may contain as many as 500,000,000 of bacteria. The 'souring' of milk is due to certain bacteria present in the milk which convert the milk sugar into lactic acid, and this acid gives the sour taste and curdles the milk.

In the process of butter-making the bacteria in the cream, if of the right kind, are beneficial. During the process of 'ripening' the cream before churning, certain bacterial products are formed which give to the butter its peculiar flavour and aroma. In order to control the ripening process, use is often made of 'starters', or pure cultures of known flavour, producing bacteria. Before these are added, however, the cream must be pasteurized in order to destroy the bacteria already in it, which would otherwise interfere with the growth of the introduced bacteria.

In cheese-making, also, bacteria are all-important. The ripening of the cheese is largely due to bacterial action, though the exact part played by the different kinds of bacteria present is not yet perfectly understood.

Bacteria play a most important part in many industries. Certain decomposition bacteria cause the retting of flax, dissolving the pectin substances and freeing the fibres. Fermentive bacteria are essential in vinegar-making, and also in wine-making.

Perhaps the best-known fact regarding bacteria is that they cause disease. These disease or pathogenic bacteria, when growing in the body, produce substances of a poisonous nature which have a direct action on the tissues. These are known as *toxins*, and each bacterium produces a specific poison. How the body protects itself against these poisons by means of antitoxins and protective sera forms a fascinating chapter of modern bacteriological research, but is beyond the scope of the present article.

This brief outline of the action of bacteria may serve to show what an important part they play in nature. They are present everywhere, and their activities are unceasing. Some we must regard as enemies, but most of them are our untiring friends, keeping the surface of nature fresh and green for us and rendering possible the perfect development of life upon the earth. See also arts. on DAIRY BACTERIOLOGY; MANURES, BACTERIOLOGY OF, SOIL, BACTERIOLOGY OF, FERMENTATIONS, PASTEURIZATION, CULTURE, SOIL INOCULATION, STERILIZATION. See also specific diseases ANTHRAX, TUBERCULOSIS, &c. [W. B. B.]

Badger (*Meles taxus*), or brock as it is still frequently called, is a carnivore allied to the Weasel family. It was long regarded as the only representative of the Bear tribe in Britain, but the resemblance is a superficial one, due to its shaggy fur, and to the fact that it plants the whole sole of the foot on the ground in walking. The fur of the badger consists of long, stiff, almost bristle-like hairs, covering the external ears, and hanging nearly to the ground.

The hairs are of three colours, but give a general effect of yellowish-grey on the upper parts. The legs and under parts are dark. The face and head are white, with two longitudinal black streaks covering the eyes and ears, and giving a very distinctive appearance. The toes are furnished with powerful digging claws, long on the fore feet, shorter and blunt on the hind feet.

The European badger is distributed over all the countries of Europe. In the British Islands it is still very general, though nowhere abundant. Mr. Lydekker notes that within the last thirty years it has been recorded from twenty-nine English counties, and that in some places it is apparently on the increase. In Scotland it occurs all over the mainland, but it is not native to the outlying islands.

The badger is strictly nocturnal in its habits. Choosing the sunny aspect of a wood-covered slope or the recesses of a forest, it hollows out a spacious burrow at the end of an oblique or winding tunnel, which may be several yards in length. Though the burrow has only one entrance from without, several tunnels ending in smaller chambers may lead from it in various directions. The main chamber is luxuriously lined with grass or moss, and within this the badger passes his days in ease and comparative security. It digs so rapidly that it can bury itself in a few minutes, and as it goes it throws back the displaced earth with its hind feet, thus baffling the few enemies willing to follow it into its earth and brave its terrible bite. The extreme tenacity of the badger's grip is due to the remarkable way in which the lower jaw is locked into its socket, so that it cannot be disarticulated without breaking. The badger is exceedingly cleanly in its habits, and its burrow differs greatly from that of other carnivores in this respect. All offensive matter—excrement, remains of food brought to the young, and the like—is deposited in a hole and covered over with earth. Very occasionally badgers may be seen sunning themselves near the entrance to their earth on warm afternoons, but they retire hastily within it at the first warning sound. It is only after nightfall that they wander about with any freedom in their search for food. They are very omnivorous, for their diet includes fruits, roots, and nuts, as well as small mammals, birds, birds' eggs, frogs and lizards, worms, slugs and grubs. They are said to have a particular fondness for the larvæ of wasps and bees, and to procure these will dig up the nests, quite indifferent to the stings of the angry insects buzzing round them. Towards autumn their appetite increases greatly, and by the beginning of winter they are exceedingly fat. They sleep within their burrows for the colder part of the winter, but it is not an unbroken sleep, and they may even come out to drink on mild nights. In the first mild days of February they emerge, very lean and starved-looking, and in a short time they begin to re-line the nest and prepare for the advent of the young ones.

The badger brings forth at a litter three to five young, which, like the young of other carnivores, are blind and naked at birth. There is much uncertainty as to the period of gestation, different authorities stating it at six, ten, and eleven months. Cases are even on record of captive badgers in which the period has been prolonged to fifteen months. Mr. Lydekker suggests, in explanation of this variability, that the ovum undergoes a period of quiescence before development, and that this period may be induced or prolonged by captivity. One observer, who kept badgers in a well-protected enclosure, states that pairing took place in October, and that the young were born in March. By the end of June the little ones could often be seen playing about the mouth of the burrow, and they soon became accustomed to the observer's presence, though the parents never relaxed their extreme wariness. The young are mature in their second year, and may live for eight or nine years, so that there seems no reason why, if they are not too much persecuted, they should not again become more abundant. It has been urged against them that they kill young foxes, that they damage young trees, and that they destroy game-birds and their eggs. But badgers have been known to live in the same earth with foxes, and they only search the trees for slugs and grubs. The damage they undoubtedly do among game-birds is very slight, and it is far outweighed by the service they render in destroying rats, mice, and all sorts of vermin. Many badgers were formerly taken alive for the cruel sport of 'badger-baiting', which was long a favourite amusement in England, but this was declared illegal in the middle of last century. The badger was put into a shallow tub or barrel lying on its side, and many dogs were set on to worry it, in the hope of drawing it from its retreat. The sport, we are told, was almost equally cruel to the tormentors and their victim.

There are various ways of hunting the badger. It is sometimes watched for and shot as it is returning to its earth at dawn. Its movements are slow and clumsy, so that it is quite unable to save itself by flight. It is sometimes dug out of its earth, but most frequently it is trapped by means of a sack with a draw-string, placed within the mouth of the entrance to the burrow during its absence.

Other members of the same sub-family of the Mustelidæ are the Skunk (*Mephitis mephitica*) and the American Badger (*Taxidea americana*). Of the latter form, several thousand skins are annually imported into England, and they supply the badger hair used for shaving-brushes, and sometimes for painters' pencils.

[J. A. T.]

Bailiff.—The duties of this official are usually confined to the farm. Sometimes they extend to oversight of some kind of the estate. In either case the bailiff is subordinate to the steward or agent in charge of the latter. Much, of course, depends on the extent of the estate and the size of the home farm. When both are extensive the bailiff has enough to do in the management of the farm without going outside the same; when neither is very large the agent may be seen looking after the farm with the aid of a foreman. This in England, and as regards the home farm. In Scotland the term

Photo Charles Reid

BADGER

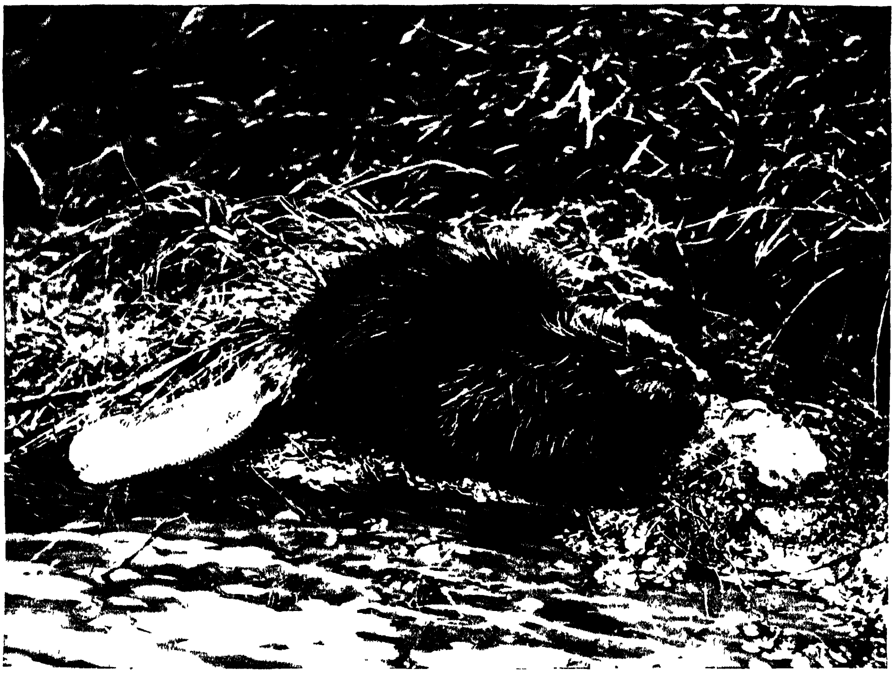


Photo Charles Reid

BEAVER

'bailiff' is not in use. Instead of it that of farm manager is used in the case of the home farm, and of steward or grieve, according to locality, in connection with the leased farm. When the farm manager takes more or less a share in the supervision of the estate, he is sometimes spoken of as land steward. In Ireland, however, the bailiff is known as such, but his duties are of necessity confined to the farm. Land management there seems to be mostly in rent collecting, in which department the bailiff is on neither side of the channel concerned. Occasionally the land steward has the woods and fences to look after; it may be the respective buildings as well. Thus, in accordance with the size and importance of an estate, do the duties of the bailiff merge into other departments of estate work.

The bailiff if he is to be in the front rank of his set must be a skilful agriculturist. A generation or two back he led the way to the farmers of his district in advanced methods of agriculture. The home farm at its best was in those days what we wish to see the college of agriculture and its attached farm in ours—an object lesson in science put to beneficial practice. The bailiff was of course in many cases simply demonstrating the ideas of the squire or large landowner. Unless, however, he had been capable in himself he could not have done this very effectively. To English bailiffs of the past is no doubt due much credit for the development of British farm live stock to the high position it now holds. The Shorthorn and the Shire have to thank them largely for the eminence they have attained among breeds of cattle and horses respectively. And they have had a good deal to do too in bringing the Thoroughbred up to its present point of perfection. Unless the trainer had good material offered him he could not have turned out many of the cracks whose feats we read of. Before, however, the young stock had got the length of the trainer's hands it was usually the watchful eye of the bailiff that had to see to their interests; and the dams had to be cared for as anxiously as the youngsters. In Ireland, also, the bailiff of the past nursed the leading breeds of farm stock to some purpose. We are afraid, however, his example in stock-breeding was almost as little followed as were the object lessons he gave in crop-raising. In Scotland, on the other hand, the tenant farmer did more in the development of the breeds of horses, cattle, and sheep than the landlord and his farm manager have done. All the same, there have been many proprietors in Scotland who have carried out important work in this connection.

Unfortunately the bailiff is in less demand than he used to be. Since the last backset that overtook British agriculture, the home farm has in very many cases been let. Had the bulk of proprietors been as well versed in agricultural affairs as their forefathers were, this might not have been of so frequent occurrence. At no time does one expect to find the bailiff so keen set with regard to business as the rent-paying farmer. In nearly every department of the farm he may be excused in being a little freer handed in outlay than the man who has to make sure of the rent feels himself entitled to be. Notwithstanding this the bailiff might have tided over the bad times as the farmer has done, had the proprietor been able to back him up and help him to adapt the affairs of the farm to the changing circumstances. As we have hinted, few of the latter class were in a position to do so. Most of them, indeed, were glad of an opportunity to eschew the practice of agriculture, consequently both home farms and bailiffs are fewer than of old. The men who are chosen to perform the duties of a bailiff are drawn, as a rule, from the middle-class farms, and are either the sons of farmers or are hired men of more than average ability. The most essential qualification, viz. an all-round knowledge and experience of farm work, is thus ensured. But for the man who aims at one of the larger and more important posts of this nature, farm training alone will not suffice. He must be well versed in accounts, be capable of measuring and laying off land, and have a sound knowledge of manures, seeds, feedingstuffs, veterinary science, &c. With the present-day facilities for attending courses of instruction in agricultural schools and colleges, the prospective bailiff is at a much greater advantage, so far as this part of his equipment is concerned, than was formerly the case.

The bailiff of to-day must be a good judge of stock as well as a good tiller of the soil. He has still the chance of getting charge of pedigree animals. But the herd, or the flock, or the stud that he happens to be associated with will fall off at his hands if he is not possessed of the requisite skill for raising and maintaining live stock above the standard of mediocrity. The latter art is more a natural gift than an acquirement. To few it is given indeed, yet a good many can acquire it. Given a love for live stock—a trait common to most of us—and an observant eye, together with some power of concentration of mind, one can do a good deal in this connection. At the worst the bailiff should be able to keep a picked lot from deteriorating sensibly.

Besides keeping the land in good condition and seeing to the interests of the live stock, the bailiff has the books to keep and periodical statements to prepare. He buys and sells, of course, and in consequence is a regular attender of the local markets. At the pedigree sale rings in which the stock he affects are disposed of, his is a well-known figure.

The bailiff at the leased farm is of the status of a foreman labourer. Should the tenant not be in residence, he then being the man in charge has a slightly better position. But this, we need hardly say, all depends on the importance of the place in question. [R. H.]

Bait.—By bait is meant solid refreshment for a beast of burden, whether for a consideration or as an act of hospitality, and custom prescribes for a horse a quartern of oats, with or without chaff. It includes water before or after feeding, as the traveller may direct, but if hay or other food is supplied it is counted as an extra, to be charged for at a hostelry. Judicious baiting enables animals on a journey to accomplish it with less fatigue and distress, and it may here be remarked that the old custom of with-holding water until after the animal has eaten has been proved to be wrong both in theory and fact. The refreshment experienced by a deep draught of water, if not colder than the atmosphere, gives a zest for food, and supplies the necessary fluid for the masticatory glands to secrete the saliva requisite in chewing. Water taken upon an empty stomach passes in three or four minutes into the cæcum, or 'water gut' as it is sometimes called, leaving the stomach free to receive and deal with the solid food almost immediately. Water given on top of a bait dilutes the gastric fluids, and has often produced colic by causing grain to swell up before receiving the natural ferments and coming under the influence of the glands of the stomach (gastric and peptic). Horses have been slaughtered at various times after drinking, in order to ascertain what is above stated, and colic in the army and in large studs has been greatly reduced since watering before baiting has been practised. [H. L.]

Bakewell, Robert, one of the most famous and successful of the early improvers of breeds of live stock. Born in 1725, he began in early life to assist his father in the management of the farm of Dishley Grange, Leicestershire, and after travelling about the country in order to become well acquainted with different methods of farming and breeds of live stock, he took over his father's business while still quite a young man. He soon turned his attention to the improvement of Longhorn cattle and Leicester sheep, and while he attained a considerable degree of success with the former, it is as the creator of the New Leicester that his fame will go down to all future generations. He also established a stud of excellent black horses, which may be regarded as among the progenitors of the Shires of the present day, and he developed a breed of pigs. Bakewell's system was one of in-and-in breeding, which was regarded as the embodiment of a new heresy in his day, but if this was not a necessity with his cattle, it is not easy to imagine how he could otherwise have developed a type of sheep entirely different from any other which was in existence in his time. He never described his methods of procedure in writing, and even in private conversation he was very reticent upon the subject, but he appears to have made no secret of the fact that his main principles were those of fining down bone, developing thickness of flesh, and producing the latter to the utmost in those parts of the animal which are represented in the most valuable joints. In a comparatively short time he transformed the big, lanky, raw-boned Leicester into a model of symmetry, excellent alike for readiness to fatten and for early maturity. The demand for his rams steadily increased, and according to Mr Prothero, whereas he let them for the season at 16*s* a head in 1755, by 1789 a society formed to extend his breed hired them at 6000 guineas. Breeders and men of the highest rank from many parts of the world visited Dishley to see the famous animals, and some of them at least in the hope of discovering the secret of his success. All were made welcome, and, indeed, Bakewell's lavish hospitality, together with his heavy expenditure on breeding and on various farming experiments, conduced to his bankruptcy in 1776. This did not cause any break in his breeding career; but he was reduced to comparative poverty in his later years, in spite of the high prices which he obtained for his live stock. His animals, some wit declared, 'were too dear for anyone to buy, and too fat for anyone to eat'. Mr. Prothero quotes a description of Bakewell as *'a tall, broad-shouldered, stout man of brown-red complexion, clad in a loose brown coat and scarlet waistcoat, leather breeches, and top boots'*, and adds that, while entertaining in his kitchen Russian princes, French and German royal dukes, British peers, and sightseers of every degree, he never altered the routine of his daily life. Breakfast at eight, dinner at one, supper at nine, bed at eleven, were parts of this routine; and 'at half-past ten, let who would be there, he knocked out his last pipe'. One, if not both, of the brothers George and Matthew Culley, who developed the New Leicester sheep into the Border Leicester by judicious crossing, had been a farm pupil at Dishley. Robert Bakewell died in 1795, when in the seventieth year of his age. [W. E. B.]

Baking of Land.—This expression has reference to the hard crust which forms upon the surface of a stiff clay soil when dried. During the process of drying the clay also shrinks considerably, with the result that large cracks traverse the 'baked' surface. Applications of lime tend to reduce the cohesive nature of clays, which are thereby rendered more friable, better aerated, and less apt to 'bake' on drying.

Balance Ploughs. See Ploughs.

Balaninus, a genus of weevils with very long, slender, curved rostrum. The most familiar example is the Nut Weevil (*B. nucum*), which is the parent of the grub so frequently found in filbert and hazel nuts. The female pierces a hole in the young nut with her rostrum and inserts an egg. This hatches in about ten days into a wrinkled, legless, white grub, which feeds on the kernel. Infested nuts often fall prematurely. When fully fed, the grub eats its way out of the nut whether on the ground or still on the tree--and buries itself in the soil, where it remains in a larval condition all the winter, turning to a chrysalis the following spring. *Treatment*.—(1) Removing prematurely fallen nuts, (2) shaking the weevils down on to tarred boards on a dull day, (3) good cultivation, which not only keeps the trees vigorous, but disturbs the hibernating weevil grubs.

[C. W.]

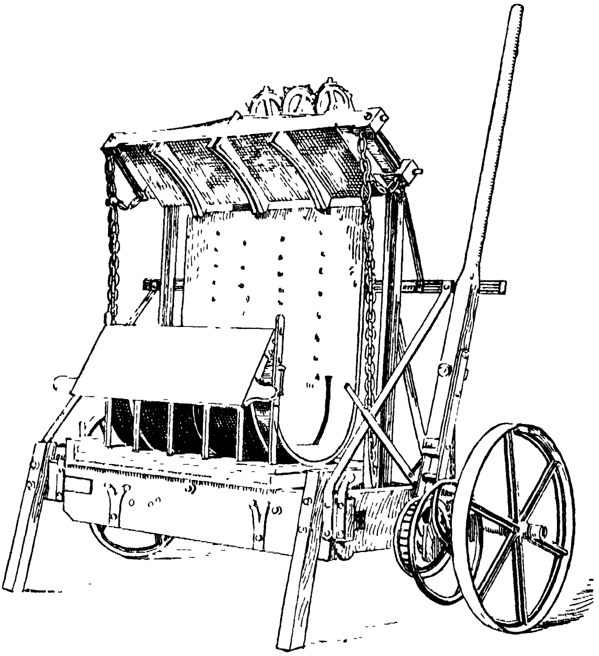
Balanitis, inflammation of the glans penis, or such a condition of the organ as gives rise to a discharge from the external orifice. A simple non-infectious mucous discharge, due to indigestion or other temporary causes, may pass under this title; or a serious infectious gonorrhœa may be meant, in the loose phraseology commonly employed, to denote mal-secretions escaping from the sheath or adhering about the prepuce. The presence of sand-like accumulations around the tuft of hair which distinguishes the bull and the ram from other farm animals, may be sufficient cause for the production of glutinous or muco-purulent matter; the existence of a polypus or of fungoid growths on any portion of the penis or 'yard', or a specific infection contracted by intercourse with an infected cow.

While any of the above causes may prove annoying to the animal and depreciate his value, the last named is of serious import, and carrying heavy responsibilities to the owner of a stud animal.

Entire horses suffer from balanitis, and a profitable season is often lost to a travelling stallion, or damages claimed against the proprietor for mares' services lost through infection conveyed *in coitu*. Rams are less often subject to this malady. Dogs are frequently found with chronic balanitis of a non-infectious type and due to dietetic errors.

Treatment. — To discover the cause it will be necessary to withdraw the penis, casting the animal with ropes or hobbles if necessary (see CASTING), as there is no certain way of distinguishing one balanitic discharge from another by the ordinary means at hand upon the farm. Before doing so, preparation should be made for syringing out the sheath, and for seizing the organ to forcibly withdraw it. A 4-per-cent solution of carbolic acid or 7-per-cent-boracic-acid lotion will be suitable, and a ball syringe is always to be preferred as needing one less hand to operate it than the instruments in common use in houses. Some fine meal with which to dust the hand and fingers will assist the operator to grasp and retain the penis, while gently but continuously exercising traction upon it until the muscle tires and releases it. Any morbid growths or fungoid excrescences may then be scraped off and dressed with the antiseptic lotion. The sheath should in such case receive a final dressing of carbolized oil or other lubricant to make easy the passage of the 'yard' when any subsequent inflammation or swelling might otherwise prove a hindrance to its protrusion and the passing of urine at the proper times. If no growth or apparent obstruction is found, but the membrane wears an inflamed or unhealthy look, an astringent injection may be prescribed, such as 3 or 4 per cent sulphate of zinc or acetate of lead, a portion being syringed up the sheath daily until amendment is observed. Some cases prove obstinate, and will be best treated by changes in the astringent remedies — a copper solution one day, zinc another, or a mixture of the three substances above named. The general health should be considered and the diet reviewed, some change perhaps being necessary. In the case of ruminants, the addition of linseed in one of its many forms may prove helpful. A few saline doses are also recommended, sulphate of magnesia or soda being given the preference. Whatever the cause of a discharge from the penis or its coverings, there should be no sexual intercourse permitted until the attendant is quite satisfied of a perfect recovery. [H. L.]

Baling Press. — The reduction of the cost of freight when transporting hay or straw, after it has been baled in a suitable press, well repays the cost of pressing, and during recent years the practice has become a very general one. Incidentally, the appearance of hay when thus compressed is much improved. Presses take many forms, and are made to be worked by steam, horse, and manual power, according to their form and the capacity of their output. Some are made to compress hay cut out in trusses, and some loose hay. Straw presses are made to compress in truss form, or in bales of more pellet form. In Howard's perpetual baling press, the straw as it comes from the threshing machine is baled automatically, the only attendant being the one man who passes the straw into the machine; though by using a mechanical feeding arm or a circular conveyer, the straw is not handled from the time the corn sheaves enter the threshing machine until the bales are formed; it is also suitable for baling hay, making one of the most com-



Combined Hay and Straw Press for Hand-power plete and effective machines used on the farm. Many efficient hand-power presses are in use, but probably Barford & Perkins's combined hay and straw press (silver medal at the Darlington Royal Show) is the best known; the ease with which it can be converted from one purpose to the other, and the simplicity of its working either as an ordinary hay-truss presser or (with guiding sides) as a full-length-straw trusser, making it equally convenient for either purpose.

Wool-baling presses are also largely employed in baling wool for transport. Few of these are used in Britain, but in the great sheep breeding countries south of the equator they are regarded as necessary.

Peat-moss presses are employed to compress the upper layers of peat to be used as litter. Both mechanical and hydraulic presses are used for this purpose. [W. J. M.]

Balk.—The original meaning of the word 'balk' is an unploughed strip of land lying between two stitches or ridges of land (selions) in an arable open common field (see Seebohm's English Village Communities, p. 4). It was also used to designate dividing strips serving as boundaries between larger pieces of land called 'shots' or 'furlongs' (quarentenæ) which were generally owned by different persons. It is now commonly used of any strip of waste or unploughed land in a field. [A. J. S.]

Balls. See MEDICINES, ADMINISTRATION OF.

Balls, Hair Balls, Concretions.—Calves and lambs are subject to the formation of hair balls in the stomach, sometimes attaining great size, and becoming hardened by the formation of viscid mucus and attraction of waste materials, condensing into a ball or so-called stone, the composition of which may be seen under the title of CALCULI or STONES. Balls of hair are caused by animals licking one another or themselves, a habit which would appear to be natural, and only occasionally producing ill effects. In the case of young calves and lambs, the hair or wool may be taken in while sucking, and the custom of good shepherds is to remove the loose strands of wool which are to be found in the region of the udder—a practice known in different parts of the country as clatting, belshing, or underlocking. Wool left upon hurdles and hedges will sometimes be licked off by lambs for mere amusement, but the risk of wool balling is undoubtedly greatly reduced by leaving none that can be accidentally taken in with the milk. Calves should not be given unstrained milk, for the loose hairs which have fallen into it have the same tendency as wool fibres to be converted into spherical bodies by the churning motion of the stomach. Balling is hardly ever known in the case of calves running with their mothers, as they take food at frequent short intervals, and have no remaining curds undigested from a previous meal—the most fruitful cause of scours and other forms of indigestion in hand-reared calves, who suffer from large meals and long intervals, given for the convenience of persons having charge of them.

The symptoms of hair or wool balling in calves and lambs are loss of appetite or uncertain desire for food, with a disposition to fill out in the left side, a drummy condition being found at intervals, and apparently relieved when there is very little distension by food. If this tympany is of frequent recurrence, the probability is that the animal will not be worth rearing, but may be profitably consumed as veal or lamb, there being a market for even the youngest. Hair balls are occasionally found in the paunch of the adult beast when slaughtered. The subjects have been colicky and difficult to fatten, but a certain amount of accommodation has been reached, and in some instances the balls have become smaller and harder, and taken up a position where they have caused only slight inconvenience. This subject will be again referred to under STONES and CALCULI. Many hair balls are rejected, dropped from the mouth in the process of rumination—a method consistent with what we know of other creatures, which swallow feathers and skins and subsequently eject them as pellets, as do the birds of prey.

Treatment of hair balling is seldom successful. Frequent small doses of oil are believed by some to cause the passage or even the disruption of imperfectly formed balls, but it is probable that the temporary benefit derived is by the reduction of tympany or flatulence. Some amateur cattle doctors have claimed to cure balling by the administration of a sprat or herring, pushing it down the throat whole, and relying on the entanglement of the ball of hair or wool in the bones of the fish. [H. L.]

Balsam.—The Balsam (*Impatiens Balsamina*) is an easily grown annual, useful either for cultivation in the open air, where it flowers freely in summer, or as a pot plant for the decoration of the conservatory. The seeds germinate quickly if sown in a little warmth, and by growing plants under glass on till the end of May, and then planting them in a sunny border, they will grow to a large size, quite a yard high, and flower freely. They require a well-manured soil and a regular supply of moisture, if grown in pots, a weekly dose of liquid cow manure is helpful. There are varieties with double flowers. Another species of Impatiens that has a value in decorative gardening is *I. Roylei*, a Himalayan plant now naturalized in England, and fairly common in country gardens. It is useful for covering unsightly places or for producing an effect on the edge of a wood. [W. W.]

Bamboo.—The introduction from Japan and the highlands of India of a number of plants of the Bamboo family has been the means of adding a new and striking feature to British gardens. For convenience they are all included in the genus Bambusa, but most of them belong to the genera Arundinaria and Phyllostachys. Altogether there are some fifty distinct kinds, but for ordinary purposes a dozen of the most distinct and decorative will suffice. They are not particular as to soil, although the best plants are developed on a good well-manured loam; but they must have plenty of moisture, a position by the side of water being an ideal spot for them. The best time to transplant them is the month of May, when they are about to cast their leaves and start into new growth. At that time the largest masses may be transplanted with safety. For purposes of propagation the clumps may be cut up into any number of divisions and replanted; they soon recover and start into vigorous growth. A peculiarity of the Bamboo family is that of flowering when they reach a certain age, generally about thirty years. Under certain conditions a plant may develop an odd culm of flowers, but this is quite abnormal, and does not affect the statement that a bamboo raised from seeds lives for about thirty years before it flowers, seeds, and dies. The plant may be divided into a number of separate pieces and these scattered over the country under different conditions, but it will not affect the time of flowering; wherever they are, whatever the conditions in which they have developed, they will all flower at about the same time. Generally they seed freely, and a crop of young plants is quickly obtained. The loss of large specimens through their flowering is keenly felt, but, on the other hand, there is no fear of such a catastrophe when the plants have been recently raised from seeds.

Bamboo (*Bambusa Simonii*)

A selection of the best Bamboos should include the following.— *B. anceps.*—Stems erect, 8 ft. high, with rich green leaves. N. India. *B. Falconeri.*—The most elegant of all the hardier Bamboos. It is particularly striking in the gardens of Cornwall and South Ireland, the graceful arching stems being over 20 ft. long, clothed with wire-like feathery branches and small pale-green leaves. N. India. *B. fastuosa.*—Stems 12 ft. or more high, short jointed, with leaves 6 in. long, 1 in. wide, bright-green above, whitish beneath. Japan. *B. palmata.*—A wide-spreading plant, the stems 4 to 6 ft. high, leaves 1 ft. long and 4 in. wide; an excellent plant for cover. Japan. *B. metake.*—The commonest and hardiest. It has rather stiff stems about 8 ft. high, leaves 9 in. by 1½ in.; another good cover plant. Japan *B nitida* has thin, gracefully arched stems, purple when mature, 10 ft. long, carrying a plumose arrangement of small bright-green leaves. China. *B. Simonii* is a tall, graceful edition of *B metake.* A grand plant to serve as a screen or shelter; excellent by the side of a wood, especially where there is water. Japan. *B Castillonis*—Stems 8 ft high, yellow striped with green. Requires shelter, as also does *B. aurea,* which it closely resembles, except that the latter has green stems. *B. flexuosa*—An elegant grower, with slightly zigzag stems 8 ft. long. China. *B. Henonis.*—Perhaps the handsomest of the Japanese kinds. It has stems 14 ft. long, gracefully arched with a plumose arrangement of wavy leaves. *B. nigra*—The black-stemmed Bamboo; rather tender, is most at home in a large conservatory. Japan. *B viridi-glaucescens.*—An elegant free grower, the stems often growing 18 ft. in length and forming perfect fishing-rods. Japan.

[W. W.]

Bampton Nott.—A breed of sheep which existed from time immemorial in the district round Bampton In the first quarter of the 19th century, crossing with the Leicester began to be extensively practised, with the result that a considerable alteration and improvement was effected, and the name of Devon Longwool came into vogue as affording a better description of the acquired characteristics of the breed. See DEVON LONGWOOL.

Banana.—The Banana (*Musa sapientum,* L.) is a large herbaceous plant belonging to the nat. ord. Musaceæ. The stem, formed by the sheathing of the leaves, is from 10 to 25 ft. high (according to variety and climate), and is surmounted by a crown of leaves which individually often measure 7 to 10 ft. in length by 2 ft in width. A large number of varieties are known, but botanists generally now believe that all belong to the same species, the differences being due to varying climatic conditions, soil, and methods of cultivation. The Plantain (*Musa sapientum* var. *paradisiaca,* L.) is a variety which does not develop sugar to the same extent as the dessert varieties, and is generally cooked as a vegetable.

Originally a native of the East Indies, the banana is now largely cultivated in the Tropics, especially in the West Indies, Costa Rica, the Canaries, and French Guiana, and although complete statistics are not available, it is estimated that in Jamaica alone about 40,000 ac. are devoted to its culture.

Provided the climatic conditions are favourable, the banana is capable of giving fair returns in almost any kind of soil, but the best results are obtained from a warm, moist, rich loam. In establishing a banana plantation the land is first freed from weeds, well ploughed, and, where necessary, drained. The plant is propagated by means of suckers, of which twenty to twenty-five are often thrown out by the parent plant. The practice varies considerably, but generally not more than four suckers are allowed to remain with the parent plant, the rest being either destroyed or used for replanting purposes. The suckers used for propagation are planted in rows 14 to 18 ft apart, about 12 to 14 ft. separating individual plants in the same row, and each sucker planted in a specially prepared hole 1 ft deep, and the soil firmly pressed down round the sucker.

Leaves and Fruit of the Banana (*Musa sapientum*)

In the Canary Islands the young plants ripen their fruit in about twelve months after planting; in French Guiana, ripe fruit is borne in ten months, and, on irrigated land well supplied with chemical manure, young suckers left attached to the parent plant have been known to ripen fruit in four to five months.

The banana is a very exhausting crop, and it has been estimated that the removal of the fruit means an annual loss per acre of 495 lb of nitrogen, 110 lb of phosphoric acid, 1056 lb potassium and sodium oxides, and 110 lb of lime. On the best plantations this large annual loss of available plant food is made up by thorough cultivation and the addition of a suitable artificial manure either alone or combined with farmyard manure.

For export purposes the fruit is cut green, and due allowance made for the length of the voyage. Great care is necessary in packing, very slight bruises spoiling the fruit, and in most cases the bunch is wrapped in cotton wool and packed in specially constructed crates. The 'season' may be lengthened by retarding the ripening of the fruit, special pruning being resorted to for this purpose.

The financial returns from banana culture are good, and the following estimate, taken from West Indian Bulletin, 1905, shows how profitable the industry is in the right hands:—

Stalks per acre	339
Gross sales per acre	£27 1 3
Cost of cultivation, &c.	6 18 6
Profit	£20 2 9

The land was weeded, ploughed, and harrowed seven times during the year, each individual plant forked round the roots once during the year, and suckered regularly. The price of raw land suitable for banana culture is £5 to £10 per acre. Similar returns are quoted from other localities, but such results are only possible where modern methods of cultivation are employed.

The banana has rapidly advanced in public favour, and the reports from banana-growing countries have increased enormously during the last ten years. In 1905, 5,500,000 cwt. of the fruit, having a monetary value of £2,000,000, were imported into Great Britain alone, the principal sources being Jamaica, the Canary Islands, and Costa Rica.

In European countries the banana is principally used as a dessert fruit, but in the form of dried meal or flour it forms the staple diet of a large number of people in tropical countries. The ripe fruit itself is very nutritious, containing considerable amounts of both proteids and carbohydrates. Below is given an analysis (Church) of the peeled ripe fruit:—

Water	73·9 per cent
Albumen	4·8 ,,
Sugar and pectose	19·7 ,,
Fat	0·6 ,,
Cellulose	0·2 ,,
Mineral matter	0·8 ,,

Excellent biscuits may be made from the meal, but it is not suitable for making into bread. Leuscher (Tropical Agriculturist, 1904) gives the following as the composition of good banana meal:—

Water	15·00 per cent
Starch and dextrin	73·92 ,,
Fatty matter	1·14 ,,
Albumen	3·27 ,,
Fibre, colouring matter, &c	4·48 ,,
Ash	2·19 ,,

The same author states that the best method for making the meal is as follows:—The green bananas are plunged into water at a temperature of 80° C. and allowed to remain for four to five minutes. On cooling they are peeled and placed in a vacuum dryer provided with stirrers which alternate and move between fixed knives.

When withdrawn from the dryer the treated bananas have the appearance of coarse flour. The flour is thrown into a mechanical sieve of 120 mesh, and all material not passing through returned to a suitable mill until fine enough.

The fibre obtained from the banana is of local importance only, and is principally used for making into cordage and coarse canvas. Manilla hemp is obtained from a closely allied species (*M. textilis*, Nees). [H. W.]

Bands. See HARVESTING.

Bane. — Under the name of bane several diseases are referred to among old writers, and the term lingers in districts of Britain, but with so many different meanings that we prefer to assign it to that commonest use of the word as applied to rot, liver rot, or fluke in sheep (see LIVER FLUKE). [H. L.]

Baneberry (*Actæa spicata*). — This is a poisonous plant of the Buttercup order (Ranunculaceæ), of very rare occurrence, being found only in bushy mountainous districts in the north of England. Baneberry is a tall perennial herb with compound pinnate leaves. It bears spikes of white flowers in May and June, and later the berries appear as egg-shaped black bodies about ½ in. long. [A. N. M'A.]

Bang or **Bhang.** — This is a narcotic and intoxicating Indian preparation of the dried leaves of the common hemp plant, which yields, as well as bang (or hashish), the fibres for hempen ropes, and the hemp seed for cage birds. The narcotic principle is contained in a gum resin secreted by glands distributed all over the plant, over stem, leaf, and flower. The quantity of gum resin produced depends on the temperature at which the hemp plant is grown. In warm countries, for example in India and Arabia, the quantity of narcotic resin is excessive. The intoxicating principle in the resin is cannabene and its compounds. [A. N. M'A.]

Banking. — The functions of banks are diverse and varied. The offices which they perform depend a great deal upon the services which are required from them. Thus the duties of the Bank of England differ widely from those of a Raiffeisen bank. In early times in this country, banking was confined to the safe custody of valuables and the negotiating of loans, if the latter class of work may be termed banking. By the end of the 18th century a considerable volume of paper money pledging the credit of banks (*i.e.* bank notes) was circulating in this country. A fear of its inflating prices, and causing the ultimate collapse of the banks, and ruining note-holders and depositors, led to the adoption of the famous Bank Act of 1844. This Act regulated the note issue and provided for its contraction. Probably great currency stringency would have resulted long before the end of the 19th century but for the development of the cheque, which, if not certified, is not technically the kind of paper money which the Bank Act curtailed. The banks cause an enormous economy of the currency by settling an almost inconceivable mass of debts by the simple device of bookkeeping. This process is known as the cancellation of indebtedness. Thus A and B have accounts at the same bank, and A pays B a sum of £50 with a cheque. No currency changes hands. B simply pays in the cheque to the bank, and credit for £50 is transferred from A's to B's account. Through local clearing-houses, or the London clearing-house, the same system may be applied to money transactions between people belonging to different banks. All deposit banks are directly, or indirectly by agents, represented on the London clearing-house. Though small cheques are rapidly becoming more common, wages are very seldom paid by cheque. Hence in agriculture, when the aggregate wages paid are high, vast sums of cash must be told off for use in the rural parts. Aggregate wages are at their highest point about harvest time. The attraction of cash from London to meet the expenses involved in getting in the harvest, is known as the autumn drain. During this drain the reserve of the Bank of England naturally sinks, but soon after it rises again as the money, through purchases from shops, finds its way back to the bank. Another service which banks perform for agriculture and the businesses engaged in dealing in agricultural produce is the loan of capital temporarily, in the form of overdrafts, in periods of the year when the outgoings of those businesses normally exceed receipts. Banks also, or institutions closely associated with them, anticipate the receipts of these businesses by discounting bills when sales are not for cash. In view of this function of financing agriculture, and other economic activities, it is important that the rate of interest for temporary accommodation should be fairly steady. This rate depends ultimately on the rate of the Bank of England, and the rate of the Bank of England depends upon its reserve. The reserve fluctuates with the state of foreign trade, and also with the need for gold temporarily all the world over, as the Bank of England is the only bank in the world which invariably pays gold on demand. The shifting of harvests in other countries than England frequently affects our reserve, but regular periodic drains the nature of which is well known are not very disturbing. There has been an agitation for some time in this country to strengthen the reserve of the Bank of England in order to prevent those unreasonable *fluctuations in the rate of interest on short loans* which are so damaging to trade. Agricultural interests are less seriously affected by them than other interests. [S. J. C.]

Banks, Agricultural. — By Agricultural Banks, people at the present time as a rule understand co-operative banks of a more or less distinct type, which experience abroad has shown to be better qualified than any other institution to supply agriculture with cheap and convenient credit for the supply of working capital. There are other means of providing working capital for agriculture; there are even other agricultural banks. Australian governments furnish farmers with advances from public funds. The Indian Government has long assisted native cultivators by means of *takavi* loans, which are State-granted advances recoverable by revenue officers. The Egyptian Government has richly endowed its own modern agricultural bank, which is a capitalist institution founded for that special purpose. There is no denying that all these institutions have done some good; but it is a limited and second-rate good. It has not produced any of the educational, thrift-engendering, capital-creating results that co-operative banks have to show to their credit. And it is very much to be questioned if such institutions — which, it will be well to remember, deal out *tax-payers'* money—can supply anything like the volume of cash which would be required under such development of the use of credit for agricultural purposes as in the public interest certainly seems desirable. There is, on the other hand, potentially no limit to the command of cash by co-operative banks For they create fresh resources concurrently with their own growth

It may be well to premise here that the term agricultural banks, however convenient, is really a misnomer, and therefore apt to mislead The foreign nations from whom we are endeavouring to borrow the institution speak of 'rural' banks --'*landliche* Darlehnskassen, causses *rurales*, casse *rurali*'—reasonably enough, because it is the *country* surroundings, coupled with the peculiar organization of country society, which make one of the systems coming under consideration which would not, indeed, be practicable anywhere else desirable under such circumstances. The particular calling, on the other hand, has nothing to do with the matter. A bank once started must be open to all callings And, indeed, the greater is the diversity of callings represented among its members, the broader accordingly is its basis, the stronger and the more stable is the superstructure likely to be, and the further will the same quantity of money go For amid a variety of callings the temporary overflow of one calling will balance the temporary slackness of another, want and supply will be equalized Therefore, really, the less purely agricultural our bank is, the better service will it be able to render to agriculture

Furthermore, the 'rural' system as foreigners have called it is by no means the only one adapted for the service of agriculture It is true that it is specially marked out for country use, and would be possible nowhere else But it does not follow that in country districts it is the only system applicable. It has this in its favour, that it can stoop down to the very humblest wants Also, it is more educating than any other, and has thereby endeared itself remarkably to philanthropists, whose support in a great measure accounts for its success and prosperity However, it is not adapted for dealing out large sums Very much more money really has been made available for agriculture by means of credit by other banks, and for large farmers other methods, commanding larger means, may be held to be preferable, if not imperative

The task which banks intended to minister to agriculture find set to them is mainly this to render security which is at present only latent or not used—really unusable, as the market is organized easily serviceable for purposes of credit. There can, of course, be no credit without security. Therefore it is wide of the mark, when endeavouring to organize agricultural credit, so to call it, to begin with the provision of funds. Find the security, and the funds will come of themselves. Capital is ever eager to find investment; but security there must be.

Now security agriculture, without question, has to offer; but it does not hold it in a marketable shape. Its security in most cases is not such as a bank would understand, or be willing to lend money upon. The merchant or the manufacturer has his business capital invested in his buildings and his goods. It is easy to ascertain what these are worth. If he draws on his banker for the value of a parcel of goods, the banker knows that the goods are there, in a marketable shape, and what they represent. The farmer's outlay and goodwill he is quite unable to appraise — and if he could appraise them he would be unable to seize them, except by some more or less costly, troublesome, or at any rate objectionable process, as, for instance, under a bill of sale The small cultivator's assets the banker is altogether at a loss to estimate

That is not all The merchant and the manufacturer want their credit only for short terms, which is convenient to the banker. He abhors long investments. These men turn over their outlay in very little time, and so three months' credit will suffice The farmer never knows with certainty when his return will come in. His crops ripen only once a year. And the first ripening may be a failure It would embarrass instead of helping him, if he had to tax other resources in order to observe his terms in respect of a debt levied for a particular purpose. The merchant and the manufacturer use their credit to embark in ventures out of the very proceeds of which to repay it The farmer has a right to be placed in the same position

Then there is the difficulty of business usages. The banker is not used to the farmer's ways, nor the farmer to the banker's. In matters of business the two may be said to speak different languages If the farmer and the small cultivator are to be helped, it will have to be by the interposition of men who understand their language and their case, and whom in their turn they themselves can understand

And lastly, there is the question of distance. The small cultivator cannot be expected to trudge a long way into town to ask for the few pounds that he wants That would mean a loss of precious time He cannot go to the bank; accordingly the bank will have to be brought to him in his village, where he can visit it on his way to or from his work

All these difficulties seem to make assistance otherwise than by co-operative methods hopeless. Co-operation means that men become their own bankers and serve out their own credit to themselves Under such conditions the difficulties of method instanced vanish These men can adapt their methods to their own peculiar wants They will have their own men, men of their own choice, their own class, with familiar faces, capable of judging of their cases, to deal with across the counter.

They will be able to set up their little bank wherever it pleases them, and is most convenient for themselves. And they may expect to adapt their collective business, gathered together like unmanageable trickling little rills into a large conductible river, to the established requirements of the great market. Janus-like, their bank will bear two faces—one a veritable farmer's face, turned to themselves, the other a business man's face, turned to the business world

With the combined resources of all its members at its back, the bank will furthermore be in a position to present to people who trust it with their money sufficiently substantial guarantees for the engagements entered into. And, as a co-operative body, it will be in a position to make itself answerable for its members' engagements, because it possesses the power over those to whom it retails its credit to hold them to their duty. Such power, which is really the unknown quantity sought for in the problem, an outsider does not possess. Hence the impossibility of his doing the business required There is a gulf between capital and agricultural want, which only the creation of a composite body composed of agricultural units can bridge over, by placing itself as a substantial pier between the two sides of the gulf, rendering bridge-building easy.

The power which a co-operative bank possesses to hold customers to their duty is really of far greater importance than the mere faggoting together of funds or liability for collective pledging Those funds and those liabilities stand for something, no doubt And good practice ought to add to them steadily, rapidly, and continually, producing something still more solid. However, after all, they represent only a 'collateral' security, a pledge to be held in reserve. The main security which the bank can give is the security which itself takes, the means with which it endows itself to exact full and prompt repayment. Publicity will make such security understood. Hence publicity ought to be studied; but the first object of a bank created for such a purpose as we here have in view must be to ensure security for itself, to invest itself with ample power to recover from those with whom it deals.

There are means for ensuring this which are common to all systems employed In the first place, there is the undertaking to trust only members of the bank itself with credit That enables the bank to protect itself by selecting its members with care. Next, there is the safeguard of ascertaining to what extent each member may be lent to, otherwise than in return for specific security. There is the safeguard of enquiry into the object and the legitimacy of the loan asked. There is, of course, the safeguard of special—though it be only personal—security taken in each case. And lastly, there is the security of carefully checking each operation, of watching each loan, of leaving nothing unexamined, which is in truth as the life-blood to the institution.

We will see how these principles can be, and have been, applied in practice There are, broadly speaking, only two distinct systems in existence, each of which is good in itself and very serviceable in its proper place, but which will not blend with advantage. The one is identified with Schulze-Delitzsch, the first organizer of co-operative credit, and his Italian pupil M. Luzzatti; the other with Raiffeisen. The difference between the two is very marked.

Schulze-Delitzsch and M. Luzzatti make, in substance, a more or less considerable share capital the foundation of their system, and aim, more particularly Schulze-Delitzsch, at its rapid and material increase. Their peculiar conception of a co-operative bank is in truth that of a business bank on a reduced scale, with less capital, which will suffice for it, because, dealing only with selected customers, interested as members, it has an assured market, the requirements of which it can foresee, and also a smaller risk of bad debts, but with more painstaking to make up for the smaller command of cash, and doing in the main ordinary banking business with the avoidance only of what is speculative. Schulze-Delitzsch laid particular stress on the accumulation of a large capital belonging to the bank or to its members, in any case in the bank's hands. Hence he insisted upon very substantial shares, ranging from £15 upwards to £50, the value of which might, indeed, be paid up by easy instalments. The object of this was to compel the holder to continued saving, by which to create a small capital. No doubt those large shares have advantages of their own However, M. Luzzatti's principle of making the shares small, but requiring their value to be paid up within little time, appears to be more in harmony with modern business habits. Additional shares may, of course, be subsequently taken up. There is another marked difference between the two systems representing essentially the same principle, and that is that Schulze-Delitzsch, although admitting the matter to involve no question of principle, gave a decided preference to unlimited liability over limited, avowedly as a means of obtaining a larger credit, whereas M Luzzatti insisted upon liability being limited to the value of the share. The advantages of unlimited liability in this application, in times of tight money, are not to be questioned; but they are outweighed by disadvantages, one of which is, that in such application the presence of unlimited liability is apt not to be fully realized by those who undertake it

However, be the share capital created ever so substantial, within the limits which the very organization of a co-operative bank imposes, and be it supplemented by a reserve fund ever so large—in some instances the reserve fund considerably exceeds the share capital in amount —the main security given by the bank will still have to be its own conduct of its business, that is, above all things, its capacity for recovering its credits The particular safeguards to be adopted to ensure this have already been referred to The selection of members need not be excessively stringent, but it should be adequate; the enquiry into the object of the loans need not be very minute, but it should establish the presumption that the demand is legitimate.

The valuation of members for credit purposes, on the other hand, is in this case of very great importance, and should be very carefully attended to. And, no matter whether the credit given be kept strictly within the limits laid down or be permitted to exceed it, it will always be well to take security, which should by preference be personal, and is in this case generally given in the shape of an acceptance backed by one or as many sureties as the bank may judge sufficient to make the backing adequate. Some banks allow the shares themselves to serve as security, some even grant unsecured credit in excess of the value of the share, holding election to stand for some moral security. In Germany some banks grant substantial credits without security. That is often very convenient, and there does not appear to have been much harm resulting from it. But it is not a good practice. For taking the share as pledge means a risk of having to seize it, which might conceivably leave the bank in the last stage all shares and no cash. Such danger should under all circumstances be guarded against. This may be done by providing that if notice should be given of withdrawal of a certain proportion of shares—say, one-fourth or one-third (wherever shares are made withdrawable, which they are not at present in this country under the Industrial and Provident Societies Act)—a general meeting should at once be summoned to decide if the bank is to go on or not. To arrive at the credit value of members there is always a special committee, *Einschatzungscommission*, or *comitato di sconto*, which marks down the credit value of each member in a book. That book is kept strictly private, in the hands of the managers, and is of course revised from time to time. [There must be a special committee for assessing the credit value of committee men.] As a record of the loan the acceptance has been found particularly useful, because it is very binding, and also because it may, in case of need, be passed on to another bank for securing more money. For current accounts, which have become very common, an acceptance is still asked for as an effective means of binding the borrower. Since transactions are likely to be many, and more or less commercial in character, it is usual to keep a record of every transaction, with a register of names, whether of members or others (acting assumedly as endorsers), showing how everyone has conducted himself. This is useful as a guide for further business. Although the acceptance is the favourite form of transaction, every other form recognized in banking may be, and is, practised. That is simply a matter of convenience. But it is well to make the credit *personal*, because pledges, whatever they be, are apt to prove inconvenient; and when they take the shape of mortgages, they may become sources of serious embarrassment. Acceptance credit is never granted for more than three months at a time, but it is very commonly renewed, so as to bring it within the range of what is useful for agriculture. A favourite method for extending the time is to renew the acceptance, when wanted, ten times, on condition of one-tenth of the principal being repaid every quarter. But even this limit is not unfrequently exceeded, and loans have been known to run on, in special warrantable cases, for ten years and more. Current accounts are, as a rule, allowed to run a twelvemonth at a time, subject to renewal.

The organization of the bank is specially devised to ensure careful checking. The general meeting elects the committee of management, which, where required, appoints sub-committees, and which, in Germany, appoints (and may discharge) the actual managers, three in number, who are salaried. Once nominated, these men really administer the bank almost independently in the first instance, but with the observance of proper safeguards, one of which is that no transaction shall be held valid without the signature of two of them, so as to compel them to check one another. Although the three have different offices assigned to them, they may in each replace one another. The three managers report collectively every year to the general meeting on the affairs of the bank. The committee's office is to lay down—subject to the rules and to any resolution passed by the general meeting—regulations to govern the administration of the bank, and to overhaul everything that the managers do, at least once every three months. Such examination is not intended as a mere audit, although auditing no doubt forms part of it, and in view of the growing volume of the business it is rightly becoming common in the larger banks to appoint a skilled accountant to act under the committee, so as to take the auditing proper off their hands. But the main object of the enquiry is to examine into the legitimacy and propriety of the managers' administration. That is a security for the shareholders, to whom, like the managers, the committee report annually. And it is necessary. For one of the fundamental rules of a bank of this sort is, that every improper risk should be scrupulously excluded. In difficult cases the managers are allowed to request instructions from the committee; and for dealing with certain administrative matters the two bodies may sit in common. A still further examination by examiners appointed by the Union of societies, whose experience covers a wider range, has become obligatory, and is distinctly useful as a means of security and a credential to the public, though its value is not quite the same as that of the examination by the committee. In Germany the members of the committee are remunerated. In Italy they are expected to serve without remuneration, and, in addition, three of them (with two more to act as substitutes) are called upon to do for a year at a time the most responsible part of the work of the German managers—though there are salaried managers as well for the executive routine work—one being required to be in attendance every day. No transaction is valid without his signature. That secures to a fuller extent real searching examination of the managers' acts by the committee. For a mere quarterly inspection is apt to become perfunctory when business grows heavy; and that is a distinct source of danger. Whatever few mishaps have occurred in Germany are as a rule traceable to neglect by the committee or 'Council of Supervision' (*Aufsichtsrat*) as an examining body.

Thus organized, as here very briefly described, co-operative banks have rendered inestimable service to agriculture. They have dealt out large sums, and in the main recovered them safely. Their business is, generally speaking, commercial, and presupposes the presence of some ready money. As a rule they are not purely agricultural, but, on the contrary, carry on a substantial amount of non-agricultural business together with the agricultural, by which blending agriculture distinctly is the gainer, because the considerable bulk of non-agricultural business passing through the bank, with its quick returns, enables the latter far better to provide for the needs of agriculture with its slow returns. The volume of non-agricultural business may be said to carry the agricultural along with it. However, some of the small banks are purely rural, if not purely agricultural. And these latter minister to the humble wants of small cultivators and village tradesmen in a thoroughly *familial* way, drawing people together and awakening a sense of community of interests. They attract deposits freely, and so supply themselves with cash for their business in its most desirable way. The great banks of Cremona, Lodi, Rovigo, Augsburg, Cosel, Insterburg, on the other hand, do a very substantial business, the Italian banks mainly with tenant farmers, many of them in a large way of business, farming 800 to 1000 ac.

The Raiffeisen system is totally different. Its aim is not to do business but to help. Of course the help given must be businesslike, or it could not continue. But the first object pursued is to help those who suffer from lack of credit, down to the very poorest, the person who may not have a penny to offer in coin, though he must be able to offer his neighbours' belief in his honesty. If he has that, provided always that he can show an opportunity for turning his loan to good account, he is not sent away. Hence the necessity of taking even extreme poverty into account in the construction of the system; and, as a natural consequence of that, a general smallness and humbleness of things in each particular bank. A substantial man may find it more convenient to deal elsewhere. But a substantial bank could not give the help which a Raiffeisen bank actually brings to the small cultivator. And a host of such small banks, covering among them the area of a large one, in this way do a vast amount of good, if not positively as large in substance, more beneficent in its division and penetration.

Poverty being accepted as a condition which has to be taken into account, it follows that no tax can be levied upon incoming members—in Raiffeisen's ideal conception, not a penny of share capital, not a penny of entrance fee. The system, so it may at once be stated, is intended for small rural districts only, in which there is a stable, scarcely changing population, everybody being more or less fixed to the soil, everybody more or less known to his neighbours and perpetually under his neighbours eyes and observation, so that his conduct and movements are automatically watched. Under such circumstances, with only small demands for cash coming in, in a way that cannot cause serious embarrassment, the necessity of till money becomes reduced to a minimum, and, once a means has been found of tapping the cash market, the common liability of all members suffices for all purposes.

Only that liability must be unlimited, unlimited for everyone—in the first place, because otherwise there would be nothing to offer to the lender that would satisfy him; and in the second—which is even more important—because without it the springs of the peculiar machinery upon which the smooth working of the entire apparatus necessarily depends, could not be kept in working condition. The bank advisedly foregoes reliance on money—in order to be able to assist the poor. It necessarily must find a substitute to secure not only its creditors but itself; and that substitute is to be found in vigilance, the searching, trying, and watching of every case, everyone watching for the common good. Far more than in the other case already spoken of, accordingly, will the bank have to be careful in the selection of its members. Hence it is a mistake to advise banks, as is sometimes done among novices to co-operative banking, to send about canvassing for members. Quite the reverse. The bank should be extremely chary in its acceptance of candidates—send them away till they conform to its rules of morality and honesty. That accounts for the almost marvellous power, such as has been publicly acknowledged more than once by ministers of State, judges of the district, and priests and clergy, which these banks have been found to exercise as agents of moral as well as business education. The bank has something to offer which is valuable to people. The people find themselves rejected because they are not good enough. There is no more powerful inducement for them to mend their ways. And in thousands of cases they have done so. The bank cannot accept people whom it cannot trust. For every member is a possible borrower, a possible administrator, a guarantor. Therefore good quality must be insisted upon. And who would be careful to insist upon such if he were not taught to realize by unlimited liability that for any misdoing of the person in question he himself would be called to account? So, again, it is with applications for loans. Under this system, under which there is none or only a very insignificant share capital, each loan must be made to act as security for itself. It is made so by very careful examination of its legitimacy and propriety, and its promise of reproducing itself. Provided that the employment is a commendable one under the circumstances and in the case of the particular person, the applicant is to have all the money that he wants, and for as long as he requires it to enable him to repay it out of its own return. But to such employment and none other will he remain tied down. And failure to employ the money as was agreed upon, or to observe otherwise the terms imposed, will bring down upon him the summary calling in of the loan at very short notice. This may sound harsh on first hearing; however, it is only reasonable and under the circumstances necessary. And it is what the late Duke of Argyll so particularly commended, writing as a comment upon it. 'Your system of strict payments and watching the loan is admirable'. Well might a Scotchman express his approval of the system, because it embodies in a more popularized form the very same principle which has helped so largely to make Scotland prosperous, the principle of Scotch 'cash credit'. But who can be expected to exercise the proper application in watching the loan if he is not prompted to it by the certainty that the borrower's default will be his own loss? Vigilance should be carried further. With the one exception of the separate accounts in the deposit departments, too much of what is going on in the bank cannot be made known among members. Publicity keeps the institution sound. By it the machinery becomes animate and endowed with eyes and ears at all points. And thus unlimited liability is made to apply an effective corrective to its own danger. You cannot exclude anyone from it. There is a desire observable to exempt wealthy members. The scheme advisedly favours the admission of better-to-do members; in fact it almost counts upon their presence. That makes things so very much easier. And it is one of the distinctive glories of this scheme that it enables such people to give useful help without any fear of their demoralizing their neighbours with gifts. Of course the unlimited liability of a number of poor men would still represent something that might be offered as security, more particularly because every one playing his comrades false would be made to suffer for it at their hands. But a wealthier man coming among the poor brings with him a very substantial and welcome contribution of fresh security to increase the common stock, which is all the more acceptable because it is likely to be found more marketable. However, he is not wanted as a mere endorsing drone. His business capacity, experience, and knowledge of the world are wanted in the bank quite as much as his liability for money. In fairness the wealthier section of the members are always given representation on the governing bodies. Such representation provides them with a sure protection for their own interests, together with the common interests of the bank. These are protected already, it is true, by the strict limitation of the lending powers entrusted to the committee, which should always be imposed by resolution of the general meeting—restricting the credit allowable to any one individual, and also the credit allowable altogether. Such measure effectively converts what to the outside world is advisedly unlimited liability, into very strictly limited liability inside. However, members may still further protect themselves by giving notice of instant withdrawal from the bank upon any risky piece of business appearing likely to be carried out. It is to the interest of the bank, in which safety must be the paramount consideration, that it should not be. Members have a right to go out at any time, and by such act to shake off concurrently *all liability in respect of engagements not already* incurred. Whatever has already been incurred ought to be known to them. Hence they have their safety in their own keeping. The bank, wanting security, is not likely to let a wealthy member go out for the sake of questionable business. Thus by the action of the wealthy man will the bank be kept safe. But it would not be so, if unlimited liability did not put the wealthy person effectively on the *qui vive.* While people are vigilant, nothing can go wrong. Therefore vigilance cannot be purchased at too high a price.

What has thus far been said will explain why Raiffeisen, while making the unlimited liability of all members imperative in his organization, should at the same time have insisted so inexorably upon the smallness of the district to be served as a second essential condition for his banks. His organization actually requires smallness. In a large district the necessary touch with and knowledge of one another could not be secured, business could not be sufficiently watched, things could not be made sufficiently public. Accordingly large districts are ruled out of the question.

Raiffeisen's third essential point is as fully justified. He insists upon entire gratuity of services given. His demand really goes further. His is a society of potentially poor people, who are to buy accessibility of credit with services in lieu of money, thereby to secure, not profits, but a common credit service, open and profitable to all, at as cheap a rate of interest as may prove practicable. Accordingly there must be no opportunity offered for pelf, because pelf might be made to mean a temptation to prefer one's own interest to the common good. Money is indeed to be got into the bank, there to become a rock of safety. That is what the bank is to work for, in order to become more independent and more useful. However, the treasure reared up is to be held in common, inalienable, indivisible. No member must have a possible personal claim in it. The prospect of sharing out might tempt covetous persons to wreck the bank for the sake of the spoils. Accordingly no man must be allowed a right to touch it. It may be drawn upon as a reserve; it may become a substantial working fund, supplying cheaper money. But it must not go to enrich a single individual. For something like the same reason shares were disallowed, at any rate partly in order that there might be no possibility of dividend. Dividend might mean an antagonism of interest between supplier and borrower of money. And, once more, services were made to be given gratuitously, in order that no officer may be under temptation to show favour to borrowers under threat of not being given a vote for a position which would be worth so much to him. Only the secretary or cashier—'accountant' is the correct German title—is allowed a small stipend. And as a consequence he must not have any say in the bestowal of money. He is not eligible to any responsible office, but restricted to purely ministerial functions.

In respect of organization these banks are thoroughly democratic. Voting is made absolutely equal among members, and the general meeting exercises supreme authority. The committee is elected, and it should be small. There can be no greater mistake than to make the committee unwieldy or deprive it of the capacity for prompt action. A loan may conceivably be wanted on the very day, and although that must be deemed to be an exceptional case, it must be provided for. Five is a good number; in very small banks three will be sufficient. Raiffeisen used to say that as soon as there was a chairman and an 'accountant' the bank might begin work. He made the chairman of the bank elected by members generally, and presiding over the committee *ex officio*. But the chairman may also be elected by the committee out of its own number. The point is of little importance. By the side of the executive committee there certainly *must* be a council of control, larger in number, to overhaul and revise very strictly and carefully all that the committee has done. This is absolutely indispensable, in this kind of bank even more than in the other. It is the great security for the bank. Wherever things have gone wrong it has been through there being no council, or the council not doing its duty. Even more than in the other case its examination should be much more than a mere audit,—in truth an enquiry into the use which the committee has made of its discretionary powers. Both committee and council report independently to the general meeting, which in such banks is certain to manifest an active interest in affairs, which interest, once more, is a most acceptable outcome from unlimited liability, though also from the smallness and family aspect of the entire institution. It should be encouraged by all available means. It will be well, as in the other case, if there is a further examination of accounts and business by a Union inspector.

The main difficulty which banks of this type have to contend with, is that of finding the requisite money in the first stages of their existence. No objection can reasonably lie against their organization, as basing all business in the first instance upon liability only. They do not deal in large amounts, nor are they subject to financial surprises. Their business is simple, steady, and regular. Therefore they do not require much till money. Current accounts are slowly making their way among them. But most lending is still done in the shape of specific loans granted for specific purposes and for specified lengths of time, the amount coming back to the bank by regular instalments. Pledging of liability is under such circumstances a perfectly legitimate arrangement. Later on there will be the indivisible reserve fund accumulating. And there ought to be deposits coming in. For this kind of bank has a rare faculty of ingratiating itself with its local public as a receptacle of savings. It has shown this to an extent extorting admiration in Germany and Italy. It has shown it to some extent in Ireland; and its firstling specimens set up in such apparently hopeless countries as India and Cyprus, where saving was not long ago pronounced out of the question, have already given proof of this useful capability. Thrift deposits should in the long run become the mainstay of village banks. Also as time goes on and banks multiply they are likely to form their own central bank, which should not be a little provider of benevolent aid from outside, but their own self-created balancing centre. However, at the outset all these things seem distant, and there is rough ground to be got over. Spoon-feeding and State subsidizing are apt to spoil the principles of the little bank, therefore they should be employed, if employed at all, sparingly and judiciously, so as not to accustom members to look for 'manna', but rather foster the virtue of self-reliance. The best people to give first help are private well-wishers taking a personal interest in their own bank. They should give it cautiously, and be sure to safeguard themselves by supervision and preferential rights. If they are willing to do the work thereby involved they should be welcome as members. Otherwise they may deposit money, or, better still, guarantee overdrafts, which secures them greater power of control. In course of time, if the bank is properly managed, the difficulty of obtaining money will disappear, and a most useful, though humble institution will be found to have been raised up in the village, supplying the first rungs upon which poor men may ascend to a better position, and humble agriculture may provide itself with the funds which it needs for its successful prosecution.

Looked at in single instances these banks are very modest little societies, and their work is equally so. However, when they come to multiply, as they have done in Germany by thousands, they become a great power for social good, for the destruction of usury, and a potent help to agriculture, supplying it with large amounts of cash advanced under the best possible conditions to ensure judicious outlay, good return, and thrifty husbanding of the proceeds.

For husbandry of the large kind the system first discussed, which from the outset relies upon cash and does not require the minute enquiry and strict safeguards of the Raiffeisen system, and therefore opens a freer range to business on a large scale, is sure to be found preferable.

Not the least valuable quality of which these banks, of both kinds, have shown themselves to be possessed, is that of calling forth further joint action for common benefit, on other ground, more specifically among agricultural folk. With the necessary money found and the practice of co-operation instilled, co-operation of every kind seems to grow up as by magic. Before an enquiry by Royal Commission established the safety and utility of co-operative banks, Prussia could not be said to possess any co-operation for agricultural purposes. Once the banks had made their power felt, agricultural co-operation became general, and was applied to all conceivable purposes, raising the number of co-operative societies at the present time to more than 20,000. The benefit is felt at all points. Co-operative supply—that is, the common purchase of seeds, feedingstuffs, implements, machinery, fertilizers, and other goods—grew up rapidly with the help of the cash found and credit placed at its disposal. Not a few co-operative dairies were formed, with the help of co-operative banks as almost their only resource at starting, repaying the debt out of the proceeds of their business at the rate of so *much per gallon* of milk used. Machinery of the most expensive kind for common use was bought with money borrowed from the bank, which money was repaid out of the hire collected for the use of the machinery. In Italy it is quite a common practice for agricultural supply societies to work hand in hand with co-operative banks, which latter, having ascertained the credit value of members, open to them a drawing account at the supply society, which enables the latter to supply these purchasers at cash prices. Unfortunately, precise statistics are not yet available, though they are to be collected in future. However, the co-operative credit placed at the disposal of agriculture means a good many millions, which are kept in circulation fructifying. And the banks have benefited society generally by effecting a reduction in the rate of interest, the value of which is all the more evident when, as is the case in Germany, a powerful central bank is enabled to guarantee its customers what is particularly acceptable to agriculturists with their slow turnover, namely, advances for long terms at a fixed, moderate rate, which in the long run remains below bank rate.

Fuller information on the present subject will be found in the author's Agricultural Banks: Their Object and Their Work (Agricultural Organization Society, 1s.). People's Banks: a Record of Social and Economic Success (P. S. King & Son, *10s* net). A People's Bank Manual (P. S. King & Son, *6d*.). Village Banks or Agricultural Credit Societies for Small Occupiers, Village Tradesmen, &c. How to Start Them—How to Work Them. What the Rich may do to Help Them. With Model Rules and Model Account Sheets added. (P. S. King & Son, *6d*.) Co-operative Banking, Its Principles and Practice. With a Chapter on Co-operative Mortgage Credit. (P. S. King & Son; *7s. 6d.* net.)

[H. W. W.]

Banks, Sir Joseph (1743–1820), was born at Revesby Abbey, the seat of his father, in Lincolnshire, and educated at Eton and Oxford. He inherited an ample fortune, which he utilized to some extent in the pursuit of scientific discovery. In 1763 he made a voyage to Labrador and Newfoundland, and five years later he went round the world with Cook. Natural history was the favourite of his scientific studies, and every department of it was enriched by his researches. He is entitled to the remembrance of agriculturists as one of the early investigators into the nature and origin of rust and mildew.

[J. B.]

Bannock. See THIRLAGE.

Bantams.—Although bantams can scarcely be included among the economic varieties of poultry, yet they cannot be denied a place in the food supply of the country. Not a few of those who keep these miniature races declare that they are the most profitable of all, in that they produce more eggs and flesh, relative to the cost of food and maintenance, than the larger breeds. Where the produce is consumed in the household that statement has a large amount of truth, but for marketing through the trade neither one nor the other would be saleable. As bantams can be kept upon very limited space, many of the denizens of our great cities are able to breed poultry where larger birds could hardly be maintained, and thus they do something to meet the needs of their families, as well as find a valuable recreation. This explains why bantams have been so popular among the industrial population. It is also correct to say that for beauty they undoubtedly bear the palm. Frequently there is a concentration of qualities and a perfection of colour in bantams not often met with in larger birds. A further attraction is found in their sprightliness and activity. They carry themselves in a most pleasing manner.

A considerable number of the larger races of poultry are now represented in miniature, and it would require a large amount of space to deal with them all, or even give a list of the different varieties. They are divided into two sections, namely, Game Bantams, that is, small specimens of the Game Fowl, and Variety Bantams. Some of the latter have distinct characters, and are not represented by larger breeds, such as the Sebrights, the Japanese, and the Pekins, but the greater number are bred on the same lines as are ordinary breeds, except in respect to size. It should be borne in mind that bantams are not, as a rule, dwarfs, but are perfectly formed. They are small in size of body, but well proportioned.

[E. B.]

Barbary Horse, the, is an inhabitant of Barbary, which includes Morocco, Algeria, Tunis, and Tripoli, lying on the north coast of Africa, and west of Egypt. They are descended from Arabs, of which they are really a branch, but they possess certain modifications, partly the result of crossing the mare of the country with good Arab stallions, and partly the result of differences of climate and food.

It must not be supposed that every horse in the above region, known by the name of Barbary, is a true Barb. As a matter of fact, the common horse of the country is small, undersized, and of comparatively small value. This is largely due to the state of oppression under which the inhabitants suffer or have suffered, which naturally did not encourage them to exercise the care and attention to breeding which is absolutely necessary for the production of high-class stock anywhere.

In Morocco and some other parts the higher class of horse, or true Barb, is found, and he is a very beautiful animal. Standing about 14.1 hands high, he has probably the most perfectly modelled head that it is possible to find, the muzzle delicately formed and so small that it will often go into an ordinary tumbler, yet the nostrils are large and capable of great dilatation. The forehead is broad, the eyes wide apart and very prominent, the ears small and beautifully pointed. The hair of the mane and tail is fine and silky, but, unlike the majority of Arabs, there is not an extravagant growth of mane, even when neglected for a lengthy period. The neck is lean and muscular, of good length, carrying a high crest in the stallion. The withers are high, and the line of the neck runs well into them. The shoulders are sloping, and lean, the barrel extremely well rounded, and the back short. The quarters are not so flat as is the case in the Arab, and the tail is not set on quite so high. The legs are short from the knees and the hocks to the fetlocks, and the size of bone is as a rule good. The pasterns are long and sloping, and the feet small but well formed, and extremely hard and tough.

As a rule these horses are fairly free from hereditary disease, such as curb, spavin, cataract, navicular disease, side bones, roaring, and whistling. As compared with Arabs, although of more imposing appearance, they are said not to possess the same speed or stamina.

The Barb was first imported into this country from Morocco by Lord Fairfax, and was generally supposed to be the ideal of the Duke of Newcastle. The old idea was that those Barbs coming from the mountainous districts were possessed of greater courage, on account of the frequent presence of scars, indicating past attacks from lions and other wild animals. During the reign of Queen Anne, numbers of Barbs were imported, but they appear to have been lost sight of, and it is doubtful if they were of very high class.

In 1724 a Barb named the Godolphin Arabian was foaled, and is reported to have been sent to the reigning king of France as a present from the Emperor of Morocco. The French king, however, not being a horseman, failed to appreciate the gift, and eventually the horse was found in the shafts of a cart in Paris. An Englishman named Coke saw him, and thinking him too good for such work, bought the horse and sent him to England, where he was some short time after given to the Earl of Godolphin. On arrival at his stud he was, by a lucky chance, mated with a mare called Roxana, who had been previously tried to Hobgoblin, but the latter horse had refused to cover her. The produce of the union between Roxana and the Godolphin Arabian was Lath, a well-known horse in his day. Other offspring were Cade, Matchem, Conductor, Trumpeter, Sorcerer, and Dr. Syntax. During the reign of the Stuarts several of the royal mares were Barbs, and these were extensively bred from, so that the amount of Barb blood in the thoroughbred stock of to-day is considerable. The Godolphin Arabian is said to have been about 15 hands high, which is considerably in excess of the usual height of the Barb; but he was probably an exceptional specimen, and as such was deemed worthy of being sent as a present to the French monarch.

The colts in Barbary generally run wild until two years of age, when they are caught up and broken in. It is not the custom to castrate them, and the only two paces that they learn are the walk and gallop.

In their warfare the Moors' tactics consist usually of swooping down in overwhelming force, or in a series of rushes at top speed, followed by a halt to enable the rider to discharge his rifle, or spear. The Arabs, on the contrary, are fond of surprising the enemy just before dawn or just after the dusk, and consequently never ride stallions but always mares; the reason being that the former, when they smell a mare, would be certain to neigh, which would immediately proclaim their whereabouts to the sentinels of the enemy.

There is a very fine breed of Barbs in the Sahara Desert, called 'the Windsucker or Desert Horse'. They cannot, however, be classed with the common horse of Barbary, they are fed on barley or wheat, and are particularly partial to camel's milk. They are capable of covering great distances, and are on that account much in request for the purposes of hunting.

Mr. Tulley, in his book on Tripoli, mentions yet another breed of Barb, to be found more towards the centre of Africa; they are said to possess the beauty of form of the high-class Barb, together with the hardiness and speed of the Arab.

South of the great Sahara Desert there appears to be a somewhat deteriorated breed of Barbs, the deterioration being in all probability due to climatic influences, the horses being much smaller, and not nearly so strong or handy.

Although the Barb is naturally a small horse, by constant crossing with native English mares the standard of the racehorse has been largely increased; and by reason of the care and scientific skill with which this has been done, there has been not only no diminution in speed and stamina, but rather an increase in both.

There is, too, no doubt that the equable climate of England and Ireland has also been a helpful factor in this improvement. Comparing the Barb with the thoroughbred of to-day he is inferior, and it is doubtful if there is a Barb in existence that, under similar circumstances, would be able to hold its own with any of the present-day racehorses.

In Leicestershire it is absolutely necessary to have thoroughbred horses (or almost so) if you wish to really hunt; and here we notice the difference of size even more markedly, the result of careful breeding, with the view of producing weight carriers.

As to the relative value of Barbs and Arabians, opinion appears to be fairly equally divided; but the general idea is that the Barb is a better all-round horse than the pure Arabian, but this is probably an error.

If we take the symmetry of the high-class Barb, and the stamina of the pure Arabian, and cross a good class Barb mare with the best of the Arabian stallions, the result should be superior to either. [G. R.]

Barbed Wire. — The use of barbed wire, now so common for fencing, is lawful in itself and so long as a fence of or containing this wire is placed entirely upon a farmer's own land (whether owned or rented by him) he will not be liable for injury caused to animals of others, or human beings having no right to be on the land, the rule of law being that there is no liability for injuries consequent upon wrongful or unauthorized intrusion on another's land (see Ponting *v.* Noakes, 1894, 2 Q. B. 281, 63 L. J. Q. B. 549). Should the barbed-wire fence, however, project in the smallest degree beyond the boundary of the owner or occupier who erects it, he will be liable for any injury caused by it either to animals or human beings lawfully on the adjoining land who may be damaged by the barbs. This would seem to follow from the principle that a man who uses an injurious thing is answerable for injuries which are the natural and probable result of the user, which principle is well illustrated by the case of Firth *v.* Bowling Iron Co., 1878, 3 C. P. D. 254, 47 L. J. C. P. 358, where land had been fenced with iron rope, and from long exposure the strands of the wires composing the rope had decayed, and pieces of it fell to the ground and lay hidden in the grass of adjoining pasture land occupied by the plaintiff. The plaintiff's cow grazing there swallowed one of these pieces and died in consequence. The Court held that the defendants on whose land the wire fence had been placed were liable to compensate the plaintiff for the loss of the cow. So, too, in Crowhurst *v.* Amersham Burial Board, 1878, 4 Ex. D. 5, 48 L. J. Ex. 109, a burial board was held liable for the loss of a horse poisoned by eating leaves of yew trees planted in a cemetery belonging to the board, which had grown through and over their fence and projected on to the meadow belonging to the plaintiff.

The principles above stated apply where the land adjoining the barbed-wire fence is in private ownership, but not, it would seem, where the barbed-wire fence separates land from a public highway; for it is presumed at law that men and animals have a right to use all the intervening space up to the fences on either side of a public highway, and consequently a person placing a fence which is calculated to cause injury to those passing would appear to be responsible for injuries that may result therefrom to those lawfully upon the highway and using it in the ordinary and lawful way. And this is so, even though the fence is entirely situated on the adjoining owner's land. There is no English decision as to the liability for injury from barbed wire separating land from an adjoining highway, but in the Scottish case of Elgin County Road Trustees *v.* Innes, 1886, 14 Court of Session case, 4th series, p. 48, it was laid down that no one is entitled to place what is dangerous to the public or to cattle and sheep on the side of a public road, either for the purpose of defending his land or his fence; and road trustees were held to have a good title to sue the proprietor of a barbed-wire fence alongside a road, where such fence was dangerous to persons or beasts using the road, for an order to remove the same. The case of Fenna *v.* Clare & Co., 1895, 1 Q. B. 199, 64 L. J. Q. B. 238 would appear to show that an English Court would have decided in the same way. The legislature has dealt with barbed-wire fences adjoining a highway by the Barbed Wire Act, 1893 (56 & 57 Vic. c. 32). This Act defines 'barbed wire' as meaning 'any wire with spikes or jagged projections', and 'nuisance to a highway' as applied to barbed wire as meaning 'barbed wire which may probably be injurious to persons or animals lawfully using such highway'. It is enacted by section 3, subsection (1) of this Act that where there is on any land adjoining a highway within the county or district of a local authority a fence made with barbed wire, or in or upon which barbed wire has been placed, and such barbed wire is a nuisance to such highway, it shall be lawful for such local authority to serve notice in writing upon the occupier of such land requiring him within a time therein stated (not to be less than one month nor more than six months after the date of the notice) to abate such nuisance. By subsection (2) of the same section, if on the expiration of the time stated in the notice the occupier shall have failed to comply therewith, it shall be lawful for the local authority to apply to a court of summary jurisdiction, and such court if satisfied that the barbed wire is a nuisance to such highway, may by summary order direct the occupier to abate such nuisance, and on his failure to comply with such order within a reasonable time, the local authority may do whatever may be necessary in execution of the order, and recover in a summary manner the expenses incurred in connection therewith. By section 4 it is enacted that where the local authority are themselves the occupiers of the land, proceedings under the Act may be taken by any ratepayer within the district of the local authority, and a notice to the local authority to abate the nuisance shall be deemed to be properly served if it is served upon the clerk of the local authority, and any ratepayer taking proceedings may do all acts and things which a local authority is empowered to do. In England and Wales the expression 'local authority' means any county council, any urban sanitary authority, any sanitary authority in London, any highway board, and any other local authorities existing, or that may be hereafter created by Parliament, having control over highways; in Scotland it means the burgh local authority within the meaning of the Roads and Bridges (Scotland) Act, 1878, the county council or a district committee thereof, and the expression 'court of summary jurisdiction' means the sheriff or sheriff-substitute; in Ireland the expression 'local authority' means the county surveyor, or the city engineer, or the burgh surveyor, as the case may be, or some person duly appointed to act for any such surveyor or engineer (section 2). See also FENCES.

[A. J. S.]

Barberry (Berberis). — A considerable number of useful, hardy shrubs belong to this genus, some of them being evergreen, whilst others are deciduous. The largest grow to a height of 15 or 20 ft., and the smallest are only a few inches high. They will grow in any kind of soil, some of them thriving in pure sand if they get moisture at the root. They also do fairly well under the shade of trees, but they are happiest in the open. One of the most useful is the common *B. Aquifolium*, a native of North America, an evergreen forming a shapely bush 6 ft. high; the leaves have spines on the margins, and they are dark-green in summer, changing to a coppery-red in winter. The flowers are yellow, and the berries dark-purple. This plant may be used as cover in woods, or for clothing bare slopes in parks, and it is quite ornamental enough to occupy a prominent position in the garden. A mass of it filling a large bed is far more effective than the Common Laurel, Aucuba, or *Rhododendron ponticum*. It is easily raised from seeds, consequently nurserymen supply it by the thousand very cheaply. *B. aristata* is an erect bush, with furrowed red-brown branches, and pendulous clusters of yellow flowers; it thrives best in the south. *B. buxifolia* is 6 ft. high, with small box-like leaves, rather large flowers, and blue-black berries. It is a native of Chili, and is a good garden plant. *B Darwinii* is one of the most ornamental of all shrubs. It forms a well-furnished evergreen bush, with small, blunt, glossy, dark-green prickly leaves, and in spring the branches are heavily laden with racemes of bright orange-yellow flowers Usually it grows to about 6 ft. in height, but in a sheltered situation it may be 12 ft. high. It spreads rapidly by means of sucker shoots; its one defect is that it is difficult to transplant unless when quite small. Plants over 1 ft. high generally die if transplanted. It is a native of Chili. *B. empetrifolia* is not unlike the last named, but has smaller leaves and is weaker in habit. By crossing this with *B. Darwinii* a very useful hybrid named *B. stenophylla* has been obtained. It is the most popular of all the Barberries, owing to the elegance of its slender branches, which are clothed with small evergreen leaves, and in spring with drooping racemes of very fragrant golden-yellow flowers. It ripens seeds, but plants raised from them are invariably either *B. empetrifolia* or *B. Darwinii*; it can therefore only be propagated from cuttings or division, but this is easily accomplished. *B. japonica* is an evergreen with stout, erect stems, and large handsome compound leaves of a bright-green colour, the leaflets broad and spiny and irregular in outline. The flowers are in large terminal clusters and of a bright-yellow colour. They are developed very early in spring. The fruits resemble sloes in both colour and size. The plant is quite distinct, and deserves a place in a sheltered shrubbery, or in the warmer parts of the country it may be used to form bold groups in an open position. It must be transplanted when quite young. *B. vulgaris*, the Common Barberry, is a native of the British Islands. It has long slender branches, with small prickly leaves which are deciduous. In spring it is covered with pendent racemes of yellow flowers, and in the winter with bright-red berries. There are varieties with purple, yellow, or white fruits; there is also one with purple leaves. *B wallichiana* is a useful dwarf evergreen with close tufted growth. The leaves are deep green, and the plant is worth growing for them alone. [W W]

Barberry (*Berberis aristata*)

Barberry.—Parasitic Fungi.—Cluster-cup Rust (*Æcidium* stage of *Puccinia graminis*) appears as bright orange-yellow spots on leaves of Barberry and Mahonia, frequently cultivated in shrubberies. The rust on the wild barberry of hedges and copses is chiefly interesting because it is a stage in the rust of cereals and grasses (see Wheat, Parasitic Fungi) On this account the destruction of barberry near wheatfields has often been recommended, and even enforced by law. This is probably the wisest course to take with rusted bushes, although it is not likely to check the wheat-rust, which can flourish in the absence of barberry.

Powdery Mildew (*Microsphæra berberidis*).—Frequent on species of barberry, causing premature casting of the foliage. Checked by spraying and by applications of sulphur See Rose Mildew. [W. G S]

Barbs. See Lampas Paps.

Bare Fallow. See Fallows.

Bark Allowance is made when timber, either standing or felled, is sold with the bark on, the measurement then being made 'over bark' and a deduction allowed on this account. The customary bark allowance varies somewhat in different localities, but it is generally (and particularly for the chief timber trees, oak, elm, and ash) 1 in. for each foot, or ½ in. for every 6 in. of the girth or quarter girth; and this amounts to a deduction of about 16 per cent on the total contents of the log as reckoned by the customary 'square-of-quarter-girth' measurement (which quaint system, prevalent throughout Britain, India, and the Colonies, of itself makes an allowance amounting to 21½ per cent of the true cubic contents for wastage in conversion). For smooth, thin-barked trees growing in close canopy, and especially for Conifers like Spruce and Silver Fir, the allowance of one-twelfth of the girth is often more than ample, although this ratio of bark to timber may easily be exceeded when the trees are rough, as is often the case in the free isolation of hedgerows, parks, and fields. For railway carriage of unbarked timber, the General Railway Classification of Goods, 1902, clause 3, provides for measurement 'by string-over-bark, with a reasonable allowance for the bark', and this allowance made is 15 per cent of the gross estimated cubic contents (square-of-quarter-girth measurement). [J. N.]

Bark-binding is an abnormal, unhealthy physiological condition in the stems of trees, due to want of elasticity in the bark for co-ordinating the counterpressure of the bark tissues to the expansive force of the wood-forming tissue of the trunk. When the normal state of tension between the bark and the wood becomes disturbed by the trees being grown on a soil or in a situation not suited to their physiological requirements (*e.g.* as regards water for transpiration), an unhealthy and sort of hide-bound condition may be induced, under which the outer bark looks hard and constricted, and becomes dry and leathery. If noticed in time, it can usually be relieved by making one or more longitudinal incisions down the stem with a scribe or a pruning-knife in the early summer-time (not in early spring, to avoid bleeding of sap), so as to allow the bark to contract. If, however, the unhealthy condition be of so long standing that the bark has lost its normal elasticity and turgidity, relief will not be afforded by this simple measure; the general health of the tree then becomes gradually more and more affected, and the annual shoots get smaller and weaker, till a moribund stage is arrived at. When recently planted trees become bark-bound it is sometimes best to cut them back close to the ground, and allow them to shoot from the stool, afterwards selecting only the strongest shoot to take the place of the former stem. [J. N.]

Barking of coppice growth and of trees is in Britain now almost entirely confined to the oak, although alder, chestnut, spruce, and larch bark also contain a considerable proportion of tannic acid of marketable value. Bark-stripping was formerly here universally prevalent throughout oak coppices and copsewoods, though now the fall in the market value of home-grown tanning bark, due to the very extensive use of imported tannic extracts and chemical preparations, has almost entirely suppressed this form of rural employment in many districts. The operation of stripping can only take place while the sap is in active flow during the springtime, and in the 17th and 18th centuries it was in English woods limited till 30th June by a statute of James I, in order to preserve the coppice-shoots of the underwood from being damaged. But as the best season for bark-peeling is just when the young leaves are beginning to flush, this will of course vary according to the given situation and the season. Generally the bark strips most easily from the middle of April till the middle of May in the south of England, from about the end of April till the middle of June in Ireland, and from May till July in Scotland. Warm, damp weather favours the operation; and the bark comes off more freely and easily in the morning or evening than during the daytime. But the earlier the peeling and curing can take place, the heavier is the bark and the richer in tannic acid. In coppices the sessile oak throws out straighter and more vigorous shoots yielding more bark and wood than the pedunculate oak, and a rather better quality of bark; but it is usually about ten days later in being ready to strip. The method of stripping varies according as coppices or standards in copses and hedgerows are to be operated on. In the underwood or hag of coppice growth (pure coppices of about fifteen or sixteen years give the largest yield and the best quality of smooth 'silver bark') the oak shoots are cut and placed in small heaps by men, and then stripped by women and boys, each provided with a large, flat, smooth stone or a big billet of wood, on which the branch is laid and then firmly beaten longitudinally with the flat part of a wooden mallet so as to part the bark all the way along, when it can easily be peeled off by hand in as long lengths as possible, and then heaped at the right-hand side of the peeler till removed to the drying stages for curing.

The bark-stripping of large trees may either be done standing (as in many parts of south-western England), in which case the timber becomes partly seasoned before felling, or else they are felled for the express purpose of being peeled. The stems are first scraped with an iron to remove moss and coarse rind that might interfere with the curing in damp weather, the small branches being cut and barked in the same way as coppice growth. Cuts are then made through the bark in 2- or 2½-ft. lengths along the stem; and then, section by section, the bark is forced off with a peeling-iron, a wooden mallet being used to tap and loosen it wherever it will not part easily from the wood; but as this bruises the soft portions and wastes the tannic acid, the use of the mallet should carefully be avoided as far as possible. The thinner the bark, the less beating is required, though with thick, strong bark it is sometimes unavoidable. Branches of pole size, as also large poles in old coppices, are peeled with the aid of a trestle formed by a pair of forked stakes driven firmly into the ground. Upon this the pole is laid, divided into 2- or 2½-ft. sections, and peeled with the barking-iron, and, when necessary, the mallet. The quality of bark depends greatly on the care and quickness with which it is dried, for in any case a high percentage of water decreases the value of bark, and if it remains long damp it may easily become infected by mould fungi (especially *Penicillium glaucum*), which rapidly decompose and oxidize the tannin. Hence in 'curing and seasoning' or drying the bark it is desirable to do so as rapidly and completely as possible by free exposure, inner side inwards or downwards, on wooden ranges or drying stages erected on dry airy spots, or if possible under shelter in wet weather. Seasoning takes from eight to ten days in dry fine weather, and fourteen or more in dull cloudy weather, during which the bark on the stages should be turned about once every three or four days. The loss in drying is generally about 32 per cent in rough thick bark and

42 per cent in smooth thin bark as regards weight, and 21 and 34 per cent respectively as regards volume. The best bark is the young 'silver bark' yielded by coppices, as a large proportion of old tree bark consists of dead tissue from which the tannin has become more or less eliminated by transformation. The average yield may vary considerably, according to the situation and given conditions of growth (coppice, standard, close highwood, and hedgerow or field). The outturn of tree-bark may vary greatly in its proportion to a 50-cu.-ft. load of timber (square-of-quarter-girth measure). In some cases it may be as low as 6¾ cwt., in others as high as 12 to 14 cwt., but the average usually varies from about 8½ to 10 cwt. of dry 'hatched' bark as ready for delivery. Usually the felling, stripping, and harvesting are done by contract at the rate of 30*s.* to 40*s.* a ton for tree-bark, and 40*s* to 60*s.* for young coppice-bark. Including chipping and bagging (costing about 8*s.* or 9*s.* a ton), and delivery to railway, tree-bark usually costs about 40*s.* a ton, and is sold at about 55*s.* to 65*s.* per ton (of 21 cwt). Against this apparent net profit of about 20*s.* a ton, and the saving of felling hire, there are, however, to be set off the risk of loss through rain, the damage unavoidably done to the underwood by haulage of timber after the stool-shoots have flushed, and the greater difficulty and expense of cutting and fashioning timber in the summer-time Hence, taking pros and cons into consideration, many landowners and agents do not now think it worth while to strip, but prefer to fell their oak timber in winter

The cessation of bark-stripping is a loss in rural districts, as it formerly afforded a regular and useful employment after heavy work was over in the woodlands, and before extra labour was needed for turnip hoeing, haymaking, and other late spring or early summer work on farms. [J N.]

Barley.—This, the hardiest of all cereals, is included in the genus Hordeum, and is, like wheat, an annual species of grass extensively grown throughout the world, from the higher ground in the Tropics to a degree or two north of the Arctic Circle in Europe.

It has been cultivated from the earliest times. It was known to the ancient Egyptians, and is mentioned in Exodus in connection with the ten plagues, for we read that 'the wheat and the barley were smitten'. It was in the barley fields of Boaz that Ruth the Moabitess gleaned after the reapers. It was esteemed as a bread-stuff by the ancient Greeks and Romans, and among the latter was the general food of the gladiators, who for this reason were known as *hordearii.* It is referred to in ancient Chinese records, and was grown by the lake dwellers of Switzerland in the prehistoric Stone Age.

The roots of barley are thin and fibrous, and develop not only from the embryo within the seed, but also adventitiously from the lower joints of the stem just within the soil. They do not descend so deeply as those of wheat, and the crop can be grown satisfactorily on rather shallow ground.

From the joints of the hollow stem, leaves arise the sheaths of which surround the stem. At the base of the flat leaf-blade are two claw-like projections, and a thin membranous pointed structure—the ligule—is present where leaf-blade and sheath join.

The inflorescence or ear of barley consists of a central stem—the rachis—on which are arranged the single-flowered spikelets, three on one side and three on the other side alternately, the whole length of the rachis, so that when the flowers all produce grain the ear appears to consist of six longitudinal rows of the latter.

Although all varieties of barleys are alike in having six rows of flowers, in some of them only the central flower of each triplet produces grain, the other flowers being either male or abortive. These are referred to below as two-rowed barleys. The flowers are naturally self-fertilized; in some varieties they never open.

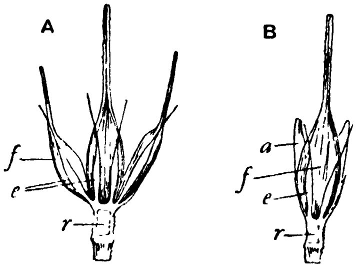


Fig. 1

A, Piece of Rachis of Six-rowed Barley showing a Triplet of Single-flowered Spikelets

B, Piece of Rachis of a Two-rowed Barley showing a Triplet of Single-flowered Spikelets, the central flower fertile, the two lateral flowers (*a*) imperfect

r, Rachis of the ear, *e*, empty glume, *f*, flowering glume, *a*, imperfect (male) flower

Crosses have been made and fertile progeny raised from them, though hitherto none has proved of any commercial value.

The empty glumes of the spikelets are narrow; the flowering glume which with the pale encloses the true grain or fruit (caryopsis) usually carries a long bristle, termed the awn or beard. The general colour of the glume is pale-yellow, but they are black or purple in some varieties.

In most of the kinds of barley grown in Europe, the fruit when ripe is so closely and firmly surrounded by the flowering glume and pale that the fruit does not thrash out as in the case of wheat. The ordinary commercial barley grain therefore consists of the caryopsis, with the surrounding chaffy flowering glume and pale. In some varieties, however, the fruits are quite free from the glume when ripe, and fall out of the ear as readily as do those of wheat. Attached to the axis of the ear is a fine bristle-like structure, the *rachilla.* When the ears are thrashed it frequently comes away with the grain, and can be then seen in the furrow at the back of the latter. When a transverse section of a barley grain is examined with the microscope there is seen a series of cell layers consisting of the glume and walls of the fruit. Just inside the latter are three irregular layers of square cells containing aleuron grains, which consist of proteid material (In wheat and other cereals there is only one layer of aleuron cells.) The remainder of the section, consisting of the white floury portion, is composed of cells largely filled with starch grains, with a certain amount of proteid substance also.

Many varieties exist, all of which are assumed to belong to a single species, *Hordeum sativum*, Pers., and this, according to some authorities, is in turn supposed to have been derived from a species, *Hordeum spontaneum*, Koch, which grows wild in the Caucasus and other parts of Western Asia.

The cultivated forms are generally grouped into three races as follows —

Race I Six-rowed Barley (*Hordeum sativum hexastichon*)

Race II Bere, Bigg, or Four-rowed Barley (*Hordeum sativum vulgare*)

Race III· Two-rowed Barley (*Hordeum sativum distichon*) —These races are stable, well-marked forms which were formerly considered distinct species.

Race I Six-rowed Barleys —Representatives of this race have all the flowers fertile, so that the ripe ear consists of six longitudinal rows of grain The rows are very regularly placed, and as the internodes of the axis or rachis of the ear are very short the grains are crowded together. Both the stems and ears are short and erect; the grain is thin and poor in quality

The six rowed barleys are probably the oldest cultivated forms of the cereal They are extremely hardy, and are well adapted for sowing in the autumn for spring folding They are also extensively grown in the southern counties of England as a catch crop Many varieties are known, some of which have free grains (var *revelatum*, Kcke.); the majority, however, have covered grain with pale-yellow glumes Two black-skinned varieties, viz var *schimperianum*, Kcke., and var *gracilius*, Kcke, are grown in Abyssinia.

Race II. Bere, Bigg, Common or Four-Rowed Barley, Winter Barley, Escourgeon —These names are given to a very hardy race of barleys characterized by having six rows of grain in the ripe ear, as in the previous race The rows, however, are not all arranged in regular order; two of them, representing the central flowers of each triplet of spikelets, are straight, the remaining four forming two irregular double rows, the whole ear being apparently irregularly four-rowed The ears are awned, and considerably longer than those of the previously mentioned six-rowed types, the individual grains are also longer, and are not so closely packed on the rachis.

These barleys are grown in many parts of Europe, in the Highlands of Scotland, and in Scandinavia, as well as in Northern Africa and Western Asia, and utilized as food for stock and also for the manufacture of spirits A small amount is used in the brewing of beer, although it is difficult to make good beer from this race of barley alone

To this class belong the varieties which are grown, either by themselves or in mixture with vetches, to be consumed in a green state in spring by sheep and other farm stock. Some are also grown in certain parts as a bread corn. Many varieties are known differing in the colour and form of the glume, length of awns, and in other characters.

The varieties most in cultivation are: (1) var. *pallidum*, Ser., a pale-yellow grained kind, grown in Northern and Middle Europe, in Japan, China, Manchuria, Northern India, and parts of America; and (2) var *cœrulescens*, Ser., a shorter and somewhat denser-eared type with greyish glumes, grown extensively in Northern Africa, the warmer parts round the Mediterranean, and warm regions in Western Asia and South America Black varieties and some with purple coloured glumes are met with. Certain kinds have naked free grain, among these being var *cœleste*, L, sometimes spoken of as Nepal wheat or Jerusalem barley, with pale-brownish grains resembling pointed wheat grains, and known in Europe for several centuries

Several naked varieties are known which possess peculiar monstrous awns The latter are short, three-pronged, and bent backwards towards the inner surface of the grain, they often bear small rudimentary flowers. The typical representative of this group is var. *trifurcatum*, Schl. (*Hordeum aegiceras*, Royle)

Race IIa —Certain forms of barley are known, which may be considered intermediate between bere and the two-rowed race These are sometimes termed *H intermedium*, Kcke The ears have two opposite rows of perfect grain, representing the middle flowers of the triplet of spikelets, the lateral flowers, however, do not always produce grain, and when they do so these are small with no awns

Race III Two rowed Barley In this race only the central floret of each triplet develops into grain the lateral flowers being staminate or small or altogether abortive

This race embraces many sub races and varieties, among which are the finest malting barleys Some of them yield well on suitable land, and when not good enough for the brewers' purposes are fed to stock They are generally sown in spring in Europe, being less hardy than the six rowed and bere races

The following sub-races are usually recognized —

Sub-race A Peacock, Spratt, Battledore, or Fan Barley (*Hordeum zeocriton*, L). This type has short stiff straw, with short erect ears, the grains of which decrease in size towards the tip, the awn spread out like the ribs of a fan. Although an ancient variety, it is not much cultivated anywhere

Sub-race B. Erect or Wide-eared Barleys. —In this group of two-rowed barleys the ears when ripe have a more or less erect habit. The grains are arranged closely on the axis of the ear, the latter becoming somewhat broad in consequence The grains are very plump, though for malting purposes they are not considered so good as the sub-race mentioned below on account of their high average of proteid con-

VARIETIES OF BARLEY

tent. The straw is stiff, and these kinds are usually grown in districts where the soil is naturally very fertile, or in high condition from the addition of considerable amounts of manure.

Varieties passing under the name of Goldthorpe, Beardless, Italian, and Shropshire barleys belong to this sub-race. The Goldthorpe barley grown so much in many parts of the British Islands is said to have been introduced by Mr. Dyson of Oldcoats, Rotherham, about 1880, but the same or a similar sort was grown in Britain as Italian barley early in the 19th century. The varieties Jewel, Diamant, Imperial, Svalöf Primus, which are grown on the Continent, belong to this group. The base of the grain in all these barleys has a transverse furrow across it.

Sub-race C. DROOPING OR NARROW-EARED BARLEYS.—These have longer and narrower ears than the preceding, and when ripe hang down. The grains are more separated from each other on the axis of the ear, and there is no transverse furrow at the base of each. They are plump and of excellent quality when the crop is well managed.

To this sub-race belongs Chevalier (or Chevallier) barley, the finest of all kinds for malting purposes. It was introduced by the Rev. Dr. Chevallier of Debenham, in Suffolk, about 1830, the original ear from which the stock was developed being selected by one of his labourers named Andrew in 1819. Derivatives of this variety under various names are cultivated throughout the world wherever good malting barley is grown. The rachilla in the Chevalier barleys is covered with short woolly hair.

Belonging to this sub-race is a group of varieties somewhat similar to Chevalier barley; the ears are, however, rather shorter, as a rule, the straw is reddish in tinge when ripe, the rachilla is not woolly, but has a few long straight hairs upon it.

Barleys grown under the names Old Common, Long-eared, and Prolific are of this class, as well as Hanna, Princess, Probstei, and other 'land' barleys cultivated on the Continent. They are generally earlier than the Chevalier types.

[J. P.]

The varieties of two-rowed barley are very numerous, and possess qualities peculiar to each, and worthy of the closest consideration. It is well to state at the outset that malting is the first and most important object in all high-class barleys. Also, that these qualities are associated with a low nitrogen content, and a preponderance of starch. In this respect barley and wheat are opposed to each other, for a strong baker's wheat must contain a high percentage of gluten and a correspondingly lower starch content, while with barley precisely opposite characters are required. The more prolific barleys are often deficient in starch, while the less prolific barleys are deficient in nitrogen, so that what appears to be wanted is a prolific barley rich in saccharine matter and poor in nitrogen.

Chevalier barley may be looked upon as occupying the premier position among malting barleys. The ear is long, and ought to contain sixteen perfectly formed grains on each side of the rachis. The grains are plump, thin-skinned, of pale-amber colour, and awned. The straw is stout, and stands up fairly well. When ripe, the skin is finely wrinkled on the surface, and in good samples is of a light buff or light amber tint. When cut across with a sharp knife, the section exhibits a pearly whiteness, and produces a white line when drawn across black cloth. A well-dressed sample should weigh 56 lb. to the bushel, and the yield per acre varies from 24 to 48 bus. Chevalier barley was employed by Hallet in bringing out his famous Pedigree variety, and Kinver barley, propagated by Messrs. Webb, of Stourbridge, was derived from the same source. Annat barley was introduced by Mr. Gorrie of Annat Cottage, Carse of Gowrie. The peculiarities of this barley are, its less closely packed ear, and a pinkish hue on the neck, just below the ear, which disappears as the plant ripens. It is a great favourite in the north, but has been accused of being uncertain in yield.

Golden Drop was originally introduced by Mr. Smith of Deanston, in Perthshire. It is described as a well-marked variety, having a stout, erect stem of a bright-yellow colour, surmounted by a short, broad, compact ear, with full-sized, plump, round grains.

Nottingham Long-eared is somewhat loose in the setting of the grain, but yields well, and the grain malts well, although not quite equal to Chevalier. Norfolk Short-necked, or Late English, was introduced on the Norfolk estate of Lord Leicester (Wilson). It is stated to be well suited for dry soils, and high and exposed situations.

Naked barley has already been mentioned as having detachable chaff, whereas in all other cultivated barleys the chaff is adherent to the grain. It has come into prominent notice from time to time, but its tender straw, and tendency to lose its ears when ripe, are serious objections to its extended cultivation.

Two-rowed Black Barley must be regarded rather as a curiosity than as a widely grown variety. The black six-rowed variety has already been mentioned as a popular fodder crop, but the two-rowed variety is late and coarse. It may possess merits for particular situations, but is not in request for malting purposes.

It would be tedious to describe all the varieties of barley which have been introduced to growers, especially as attention is at present principally fixed upon three or four leading sorts. Among those which might occupy attention in a monograph devoted to barley may be mentioned Noble Barley, discovered by the Rev. Mr. Noble of St. Madoes, Perthshire, Italian, probably the source of Golden Drop barley; Pomeranian or German, cultivated in the north of Scotland; and Common or Early English Barley, a widely grown variety, said to be adapted to a wider range of soils than any other sort. We must, however, leave the consideration of those barleys which may be classed with Chevalier and kindred varieties, and pass on to notice certain kinds of distinct character which separate them clearly from those already mentioned. Among them Archer's barley occupies a prominent position. The most marked feature in this barley is a small bristly brush or rachilla at the germ end of the grain, which enables them to be easily sorted from the smooth-ended barleys of the Chevalier type. This peculiarity is persistently inherited (Beaven), and may be used for identification. It is also known as Archer's Stiff-straw, and is characterized by a short neck, a somewhat grey colour in the grain, and somewhat later ripening than some other sorts. It is unquestionably an old variety, and its origin is unknown. It is a great favourite, and may be regarded as a rival to Chevalier barley. It is generally allowed to yield better than Chevalier, but its nitrogen content is higher, so that while it excels in quantity it slightly fails in quality.

Goldthorpe Barley is another leading sort, which is easily distinguished by the battledore shape of its ears. It was first observed in 1889 by Mr. Dyson of Goldthorpe, who raised it from a single ear resembling Spratt barley, but with a larger and better coloured grain than Spratt. Whether originally derived from Spratt (*zeocriton*), or from a variety of *distichum* resembling Spratt in outward form, we cannot say, but the peculiar shape of the original ear is preserved in all its descendants. It ranks among the wide-eared barleys, and has usually been successful in competition with any other wide-eared variety. It possesses a low nitrogen content, and in trials made in 1891 and 1893 it yielded more extract than any other sort. In an exhaustive paper read before the London Farmers' Club by Mr. E. S. Beaven of Warminster, in December, 1905, Chevalier, Archer, and Goldthorpe were spoken of as the three barleys which divide the attention of brewers.

Barley Cultivation.—Quality is the principal aim of barley growers. The profits of barley cultivation almost entirely depend upon quality, as no cereal varies so much in price according to its properties. Of late years the price of the best samples has been reduced on account of the use of maize, rice, sugar, and other substitutes for barley malt. The removal of the malt tax was agitated for by farmers, but the substitution of a tax on beer at once led brewers to look out for cheaper sources of saccharine matter, and resulted in the neglect of the higher classes of barley. This led to a second agitation for 'pure beer', defined as a fermented liquor composed of water, malt, and hops, but hitherto Parliament has not interfered with the trade, and beer is now manufactured from a great variety of materials.

The cultivation of barley has unquestionably declined and given way to a much larger acreage of oats. Seasons have not of late favoured the production of the best classes of barley, which require a mild warm summer, free from night frosts or severe droughts.

Success in barley cultivation depends upon a number of circumstances, some of which are beyond human control, while others are too often neglected. It will assist the reader if these various circumstances are placed before him in the order in which they occur to the grower, each item being worthy of special attention. They are as follows:—

1. Climate and soil.
2. Condition of the soil.
3. Tillage or cultivation.
4. Variety and seed selected.
5. Time and method of sowing.
6. Manuring.
7. Character of season.
8. Ripening or maturation.
9. Harvesting.
10. Threshing and dressing.

If all these conditions of success can be combined, a first-rate sample of barley becomes a certain result; but if one is wanting, partial failure is just as sure. The best barleys are grown in the eastern, south-eastern, east-midland, and southern counties. These counties are in many cases situated on the Chalk formation; but the Tertiary deposits, the light sandy soils of Norfolk and Suffolk, the limestone soils of the Lower Oolites, the soils of the Upper Greensand, and of other sands such as those of Thanet and Hastings, the New Red Sandstone of the Midlands, and the lighter description of Drift soils, are all adapted for this crop. Good barley may be grown in Shropshire, Herefordshire, and other western counties, but the primest samples are produced in Cambridgeshire, Bedfordshire, Nottingham, Northampton, Lincolnshire, Essex, Kent, and other counties of the east and south. Wiltshire is a good barley county, as are also Hants, Berks, and Dorset. In Scotland the best barleys are grown in the eastern counties, from Berwick to the Lothians and Forfar.

The soil ought to be light in texture, naturally drained, calcareous in character, and adapted for turnips and sheep husbandry; and all such soils will grow good barley.

2. Condition of the Soil.—If land is too rich from direct manuring, as, for example, when sheep have been folded over it with a liberal allowance of cake, the crops may be abundant, but will be lacking in quality. A medium condition is best, hence barley after wheat often yields a better sample than after roots folded. According to the Norfolk rotation, barley follows roots, but there are objections to this course. Many good samples are thus produced, but care should be taken that the land is not too rich. Barley after clover often succeeds particularly well. Barley seems to require constant and regular feeding, and the land ought to abound in plant food in a condition for gradual absorption rather than in a crude and newly added condition.

3. Tillage or Cultivation.—A fine and uniform tilth are important. They are best secured by ploughing up closely behind the sheepfolds, or by autumn and winter ploughing in the case of corn stubble. A cloddy and harsh condition of soil is inimical to success, and folding during wet weather, or late folding, are both injurious to the barley crop. In most cases a single ploughing, followed with harrow-

ing and rolling, secures a sufficient tilth; but in other cases 'running back' or reversing the furrow (but not cross-ploughing) is recommended. Barley does best on a shallow, finely reduced seed bed, and the ploughing ought not to be more than 4 in. in depth.

4. VARIETY SELECTED.—Proper selection of seed does not only mean choosing a suitable variety but also a good sample of seed. The kind of barley may be supposed to be the one usually grown in the locality, such as Chevalier, Archer, or Goldthorpe, and the barley grower may only look out for a barley of good appearance and quality The merits of a new sort—it may be a Garton or a Hallett, a Kinver or a Stiff-straw—may prove attractive even at a high price per bushel, and it is well to give such selected sorts a trial. Seed grown once from a good stock always tells well, and the quality of the bulk for malting purposes may easily justify the extra expenditure. Barley is not considered to require that change of seed which is so important for oats and wheat, and a good sort ought not to be lightly relinquished if it has proved itself suitable to the soil Seed barley should be sound and unstained by weather. it must not have heated in the rick or been too closely dressed Good screenings from pedigree seed may be used without hesitation, as it 'seeds' the land more thickly than stouter barley Pedigree barleys are always thoroughly dressed and free from broken and defective seeds, and may be sown at the rate of 6 pecks per acre, where 12 pecks of ordinary seed would be required.

5. DRILLING is preferable to broadcasting because the seed is deposited more uniformly as to depth and distance, and this induces a regular 'braird' and more equal growth and ripening. Early sowing is always safer than late sowing. March is the best month; but if the land is ready, the seed should be drilled in February, or even in January. April is not too late, and good crops have been obtained from May sowings. The risks increase after the middle of March, and well-filled grain and stiff straw are associated with early sowing.

6. MANURING.—On account of its short growing season barley is only able to utilize sources of plant food that are to be found in the surface soil in readily available forms. It is therefore more dependent on proper manurial treatment than any of the other cereals. Suitable manuring increases the yield of grain and straw, improves, although in a much less degree, the quality of the grain, and hastens the time of ripening. But skill and judgment must be exercised in manuring the barley crop. On very rich land, or land too highly manured, the barley tends to run too much to straw, the crop becomes liable to lodge, the harvest tends to be late, and the grain to be imperfectly matured, light, and of poor malting quality. Good land on which roots have been fed off after previous liberal manuring, should be in a suitable condition for the production of large barley crops. Lands from which roots have been removed, or which have been less liberally treated, may require to have special manures applied in order to produce good crops. The yield is mainly dependent on the supply of available nitrogenous manures, and these must be of a quick-acting character. Nitrate of soda and sulphate of ammonia are the most suitable forms The nitrate gives the greater yield of straw, but the ammonia is somewhat more favourable to the production of malting grain of good weight and quality. For general purposes the use of both is probably best, the ammonia to be applied with the seed, the nitrate of soda as a top-dressing soon after the crop has brairded. The quantities to be employed may vary from ½ to 2 cwt. per acre, according to the condition of the land. The addition of superphosphate at the rate of from 2 to 4 cwt per acre is important. It has little effect on the straw, but has a marked effect on the weight and quality of the grain yield. The addition of a potash manure is also generally useful The potash strengthens the straw and adds to the weight of both grain and straw. Dr Aitken found (Highland Society Transactions, 1886, p. 367) that sulphate of potash produced a stronger and stouter straw than muriate of potash. Kainit is a very suitable form of potash applied at from 1 to 3 cwt. per acre The use of a combination of all the three manurial ingredients gives the largest crops, the heaviest and plumpest grain, and the earliest harvest, and 1 cwt. sulphate of ammonia applied with 2 cwt superphosphate and 1 cwt kainit should give an average increase per acre of 10 to 12 bushels grain and 6 to 7 hundredweights straw.

7. The CLIMATE most suitable for barley is cool rather than hot, and burning summers or forcing weather during the late stages of growth produce pinched, hard, and unkind samples. The counties above named are climatically suitable for barley, and England generally is better adapted for producing good malting samples than Scotland or Wales.

8 RIPENING should be gradual, and night frosts in July are destructive of plump samples. Barley should be thoroughly ripe before it is cut, the heads should be bent down, and the grain hard and finely wrinkled on the surface.

9. The HARVESTING of barley is very important. Severance may be effected by mowing, and in many districts the crop is allowed to lie in swath, and is carted loose. In others, and especially in the north, it is bound into sheaves by harvesters. Equality in colour is best obtained by mowing and turning, but the method used is regulated in a great manner by climate, custom, and season. Heating in the rick is fatal, as the least suspicion of barley being mow-burnt causes the buyers to pass it by.

10 THRESHING should be done carefully, and the distance between drum and concave should be so adjusted as to avoid breaking the grain. The awning or 'hummeling' should not be too severe, as broken ends interfere with free germination in malting. Barley ought to be well winnowed, screened, and well 'turned out of hand', and should be perfectly sweet and well coloured. Freshly threshed barley is sweeter and commands a better price than when it has

been lying long in heaps, and if this is unavoidable it should be turned at intervals of a fortnight.

A good sample of barley grain for malting purposes should possess the following characters:—

1. High germinating capacity not less than 90 per cent.
2. High starch content and low percentage of nitrogenous compounds.
3. Thin puckered 'skin'.
4. Mealy, floury appearance when cut across.
5. Uniform colour pale-yellow, with no black points or other discoloration
6. Freedom from broken grains.
7. Absence of musty odour.

There yet remain a few considerations which fall outside the ordinary routine of barley cultivation There is, for example, charlock, which often interferes seriously with the success of the crop. The system of spraying with copper sulphate, introduced by Mr Strawson, is now largely practised by many advanced growers (see art Spraying). Charlock is more prevalent on late-sown barley, and one of the best preventives is early ploughing and dressing, so as to encourage germination of the charlock before drilling. Charlock is seldom seen upon winter-sown crops, because frost destroys the seedlings on their first appearance. Similarly, winter ploughing and harrowing causes germination of the pest in mild weather, and the subsequent destruction of the young plants, and this is equally true of January or February ploughing Winter-sown barley is not subject to those floods of charlock which inundate late sowings

Wireworm is the chief insect scourge to which barley is liable It decimates the crop during its earlier stages, and appears to be as active in winter as in spring Heavy and repeated rollings are the best check, and if a dressing of 5 cwt of salt and 1 cwt of nitrate of soda, well mixed together, is applied simultaneously with rolling, the worm is generally discomfited. Barley is also subject to the attacks of the Gout Fly (*Chlorops tæniopus*), which causes a strangulation of the ear in the sheath (see Chlorops); and of the Corn Saw-fly (*Cephus pygmæus*), which infests the straw and cuts its way through the nodes (see Cephus) The Hessian Fly (*Cecidomyia destructor*) and the Frit Fly (*Oscinis frit*) are also numbered among the insect enemies of barley.

Rust and Mildew often affect barley, but there is no remedy except good cultivation, and this cannot always be relied upon as a preventive See also Barley.—Parasitic Fungi.

Comparative Importance of Barley as a Crop —The area under barley in Great Britain, according to the most recent statistics, is as follows —

	Barley	Wheat	Oats
England	1,410,287 ac	1,701,201 ac	1,880,475 ac.
Scotland	212,134 ,,	48,641 ,,	962,972 ,,
Wales	91,243 ,,	41,073 ,,	207,929 ,,
Great Britain	1,713,664 ,,	1,796,915 ,,	3,051,376 ,,

These figures show that England is the principal theatre of barley-growing in Great Britain, Ireland only contributes 154,000 ac. See also art. Barley, Statistics of.

Concluding Remarks.—Barley is principally grown for malting, but inferior samples are of great value for distilling, for pig-feeding, and as a food for stock. Barley meal is the best food for fattening pigs which can be named, and is an excellent adjunct in the fattening of cattle. Whole barley is a good horse corn especially when grown with oats, under the name of 'dredge'. Brewers' grains are always in request for milking cows and store pigs, and malt is valued as a food for fattening lambs, so that barley in its several forms is indispensable on all farms. It is also used as a human food. English-grown barley gives place to none in quality, and the English climate is particularly

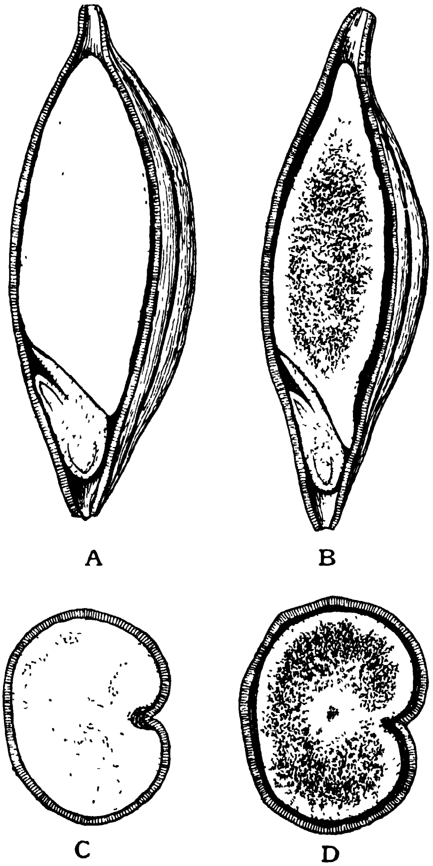


Fig 2

A, Well matured Barley Surface of longitudinal fracture B Imperfectly Matured Barley Surface of longitudinal fracture C, Well-matured Barley Surface of transvere fracture D, Imperfectly Matured Barley Surface of transverse fracture

(All magnified eight diameters)

suitable for the development of the crop. Barley straw is inferior in quality both for fodder and litter; but when (as is often the case) it is associated with a proportion of young clover, its feeding properties are much improved, and it then becomes a good food for working horses.

[J. Wr.]
[R. P. W.]

Barley. -Parasitic Fungi.—

1. Fungi which appear on the ears and grain only:—

EAR-SMUT.—The deterioration of a sample containing smutted barley is serious, because it not only contains a number of broken and badly filled grains, but in threshing the whole bulk becomes contaminated with the sooty smut, which makes the healthy grains dull and dirty instead of bright and clean. Two distinct forms of barley-smut have been recognized, and traced to the action of two species of smut fungi (Ustilagineæ). The commoner form, or 'coated smut' (*Ustilago hordei tecta*), has the fungus spores retained in a skin consisting of the walls of the grain, and the ears frequently do not unfold fully, but remain caught in the sheath; the greater part of the smut powder is therefore retained in the ear till liberated during threshing. The other form, 'naked smut' (*Ustilago nuda*), is less common, and differs in that the ears unfold and the smut powder is scattered before harvest. The life-history of the two fungi is almost the same, but the spores of the naked smut are more resistant to fungicides. The black powder in the smutted ears consists of masses of fungus spores, which are distributed in many ways, especially by adhering to the husk of barley grains. The spores do not infect barley plants directly, but in moist conditions each gives off a short transparent tube (promycelium), which bears tiny transparent secondary spores (conidia), the whole process may be observed by sowing a few smut spores in a drop of water, keeping moist, and examining every few hours under a microscope. The conidia, or sometimes the promycelium, infects the barley plant in the earliest stages of growth, having effected an entrance the fungus filaments grow and keep pace with the growth of the plant. At this stage the presence of the fungus is not perceptible, except that infected plants are frequently more robust and taller than healthy ones. When the ear is formed the process of spore-formation begins, the food material inside the grain is used up, and the swelling mass of dark-brown spores breaks its way through the outer walls of the grain. Until recently the above was regarded as the only way in which the barley plant could be infected, but newer observations point to infection during the flowering stage of the barley. The smut spores fall into healthy ears, and germinating at once infect the young grain and pass the winter inside the germ without killing it, so that when it sprouts next season the seedling is already inhabited by the fungus.[1]

Prevention.—The methods in use aim at killing the smut spores adhering to the husk without injuring the grain, the fungus harbouring inside the germ cannot be reached, nor is it yet possible to separate infected from healthy grains. The practice of steeping seed grain in some fungicidal solution is an ancient one, and is generally regarded as an effective preventive. The following methods may be recommended:—[1]

(*a*) Make a heap of the grain, and moisten it thoroughly by turning over frequently and watering it with a solution of bluestone (copper sulphate), used at the rate of 1 lb. bluestone dissolved in 1 gal. water for each four-bushel sack of seed; turn the grain several times during the next eight or twelve hours, then spread it out till dry enough for sowing or drilling. If dry, the grain will keep without injury for a day or two, but it must be kept away from poultry, as it is poisonous.

(*b*) Formalin is now used with good results. This substance is a clear solution, which can be purchased for about 2s. a pt. (standard Schering's formalin is 40 per cent strength). When used for seed-dipping, 1 pt. formalin is added to 36 gal. water, this amount being sufficient to treat from 40 to 50 bush. seed. The grain is moistened completely, as just described for copper sulphate, and left about two hours before drying. Another method is to take about a bushel of seed in a sack, and hang it in the formalin solution for about ten minutes, then dry for sowing. Formalin has this advantage, that any grain not sown is after exposure to the air non-poisonous to poultry.

Copper sulphate and formalin have been found to injure the germination of the grain, chiefly because they retard the growth of the seedling roots, on this account the following has many advocates:—

(*c*) Hot-water treatment. Soak the grain about four hours in water, then take a bushel at a time in a basket lined with sacking, and dip it into a boiler with water at 130–135° F. (using thermometer) for about five minutes, then dry for sowing. The secret of success is to keep the water at the above temperature, and as each dipping of seed cools it, there must be some means of heating up again.

ERGOT may occur in barley, but it is comparatively rare (see RYE).

STINKING SMUT or BUNT is known, but not in Britain (see WHEAT BUNT).

RED MOULD and other moulds may cause trouble on the malting floors, either because the grain has been badly harvested, or because of the dirty condition of the buildings, which ought to be periodically cleansed.

2. Fungi first observed on the stem and leaf, but may extend to the ear:—

LEAF-STRIPE.—A fungus (Helminthosporium) brings about death of barley seedlings. This leaf-stripe disease is much commoner than is generally supposed, although it is only within recent years that its importance has been realized. The symptoms are flagging of the leaves, accompanied by yellowish or brown spots and stripes, and the plants attacked are stunted in size. If the plants are vigorous they outgrow the attack, and only a few of the lower leaves show traces of the disease. Frequently, however, the ear is affected, and the plant may be 'blind', or the ear emerges in a stunted half-withered condition, with the grains quite aborted or badly nourished. The grains may be recognized in samples by being brownish at the tip end and lacking plumpness. The fungus enters the germinating seedlings, and soon produces yellowish spots by destroying the green colouring matter. The spots dry up later and become brown or reddish-brown stripes, along which the leaf-blade splits into strips and dies off prematurely. The disease may appear only on isolated plants, but we have seen cases where almost every plant was affected. The fungus spores are dark in colour, long oval in shape, and divided by several cross walls The spores are carried adhering to the husk of the grain, or they may occur in old stubble

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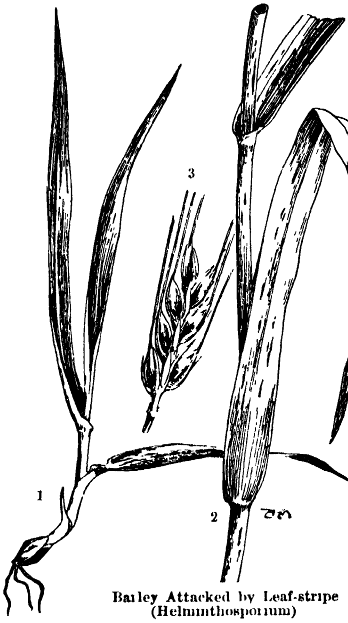
[1] A useful account of this in Jour. of Board of Agriculture, xii, 1906, p. 669.

[1] See also Board of Agriculture leaflet, No. 92.

Prevention—There is reason to believe that the fungus harbours on dead plants everywhere, and finds its opportunity of attacking barley and oats in the seedling stage. The influence of season has been observed, and any condition which checks growth is favourable to the fungus Hence, care should be taken in cultivation to ensure a vigorous and unchecked growth of seedlings. A timely dressing of nitrogenous manures may help the crop over this critical stage, but excess of these has been observed to promote the disease. As the spores adhere to the grain, the treatment prescribed for barley smut can be recommended, and it has been proved to be fairly successful. The application of lime will check this and other fungi (*e.g.* 'finger-and-toe' of turnips), partly by destroying the spores, partly by its beneficial effect on the growth of the crop.

BARLEY RUST.—This is recognized by the formation of yellowish spots or stripes, from which an abundant yellow powder is given off. The lower leaves are first attacked, and the rust extends upwards, frequently reaching the ears, so that the grain is badly filled Barley rust is not nearly so common in Britain as wheat rust; so far as our experience goes, it is rare. The disease is accompanied by a fungus of the genus *Puccinia*, several species of which have been identified on barley, but their distinction is difficult and need not concern us here Probably the commonest is a form of *Puccinia graminis*. The different phases in the complex life-history of this fungus are important in connection with its prevention; they will be found in the article on WHEAT PARASITIC FUNGI How this rust finds its way from the barley crop of one year to that of the next year is a problem by no means solved Rust may be carried over, growing on certain weed grasses, *e.g.* couch grass and some bromes. It has been observed for several years that a plot of winter barley sown in autumn, beside plots of wheat varieties, did not become rusted in the following summer, although the wheat was badly attacked. Methods of prevention are considered elsewhere (see WHEAT, PARASITIC FUNGI); the most promising method at the present time is the selection and the breeding of rust-proof varieties.



Barley Attacked by Leaf-stripe (Helminthosporium)

1, Seedling, 2, Part of stem and leaf, 3, Defective ear

POWDERY MILDEW.—Barley, like wheat and other grasses, may be attacked by powdery mildew of grasses (*Erysiphe graminis*). This forms white mouldy patches on the lower parts of the plant, weakening it, and causing the grain to be of inferior quality.

SHEATH-SMUT — This is produced by a species of smut fungus, which makes its appearance in the sheaths. It is comparatively rare on barley; if it appears, the straw should be destroyed, or at least not used for fodder or litter. [W. G. S.]

Barley, Pot and Pearl.—Like all the cereals, barley is valued as a foodstuff chiefly for the carbohydrates which it contains, and only in a much smaller measure for its proteids. The following analyses will be sufficient to demonstrate both the strength and weakness of barley in this respect:—

	Water.	Proteids	Fat	Carbohydrates	Cellulose	Ash	Ratio of Nitrogenous to Non-nitrogenous.
Barley, grain	13·78	11·16	2·12	65·51	4·80	2·63	—
,, shelled	14·05	9·66	1·93	66·99	4·95	2·42	—
Pearl barley	12·82	7·25	1·15	76·19	1·36	1·23	—
Barley meal	14·83	10·89	1·23	71·85	0·47	0·63	—
,, flour	14·83	11·38	1·53	71·22	0·45	0·59	1 · 6·4

Barley is thus inferior to wheat in proteids and carbohydrates, but it has more fats, cellulose, and ash. It occurs on the market in two forms: pot, Scotch, or milled barley and pearl barley. The former is the grain deprived of its husk and roughly ground, while in pearl barley the grinding has been carried further so as to produce a round white grain. As in the case of wheat, this desire for apparent purity as judged by an artificial standard involves the loss of useful foodstuffs. The outer coats of the grain consist almost entirely of indigestible cellulose, but immediately within these lie cells containing albumin and similar proteid bodies, and excessive grinding by removing these diminishes the proteid value of barley by about one-third, as the above analysis shows. Barley meal is made by grinding the whole grain, while the so-called patent or prepared barley is pearl barley ground into flour. When barley has been allowed to germinate under suitable conditions of heat and moisture, malt is formed (which see); the change principally consists in the transformation of some of the starch into maltose or malt sugar by means of a ferment called diastase, developed within the barley itself.

The proteids of barley differ from those of wheat in a very marked manner, inasmuch as they do not form glutin on the addition of water, but remain soluble in the form of albumose, globulin, and albumin, what have been called 'soluble albuminoids'. Two results follow from this peculiarity. Owing to the absence of glutin, barley meal or flour cannot be made into loaves, the so-called barley bread being really a mixture of barley and wheat. The other point is the large amount of nutritive matter which barley gives in solution, whether in broths and soups or as barley water. This last is generally made by digesting pearl barley, though pot barley gives a richer solution; it forms an albuminous drink for invalids, and is often added to cow's milk intended for infant consumption, in order to lessen digestive difficulties. These arise from the fact that the casein of cow's milk curdles in heavy clots in the stomach, whereas human milk curdles in light flocculent masses, and so is more easily attacked by the gastric juice. The action of barley water is almost purely mechanical; by its glutinous consistence it keeps the particles of casein apart, and so tends to prevent curdling in mass, while its own albuminous contents make it fairly nutritious.

The salts of barley, as estimated from their ash, are rich in phosphorus and iron. Barley bread or barley cakes are less digestible than wheat and more insipid. There are no special disorders traceable to diseased barley. [J. K.]

Barley, Products of.—The barley plant furnishes directly two products of economic importance in the *straw* and the *grain*.

Barley Straw.—The straw serves mainly as litter and food for stock. As *litter*, owing to its softness and leafy nature it is inferior to wheat straw in durability and cleanliness. As *food* its value is largely determined by the degree of ripeness of the crop when cut. If reaped in the same state of maturity as the other cereals it is nearly as nutritious as oat straw, and superior to wheat straw. Owing, however, to the general practice, especially where grain of high malting value is expected, of allowing the barley crop to attain greater maturity than the other crops before cutting, the straw is usually little, if at all, more nutritious than wheat straw. Its value will also be affected by the other variable factors (*e.g.* season, soil, manuring, &c.) by which the growth of plants in general is affected.

Published data, mainly of German origin, indicate that the *average* composition and digestibility of barley straw is approximately as follows:—

	Composition	Digestibility (by ruminants)
	per cent	per cent
Water	14	—
Crude protein ('albuminoids')	3½	25
Ether extract ('oil')	1½	40
Nitrogen-free extractives ('carbohydrates')	37	50
Crude fibre	39	55
Ash	5	—

As the straw ripens, the proportions of crude protein and of nitrogen-free extractives will tend to sink, and of crude fibre to rise, the sum of the two latter remaining, however, fairly constant at about 75 per cent of the total weight of the straw. Included in this will be, as a rule, about 25 per cent of pentosans—material which is probably of lower feeding value than cellulose.

Taking into account the fact that, as a rule, only about two-thirds of the crude protein is really material of a true protein nature, straw of the above composition will have an 'albuminoid ratio' of about 1 . 70. According to Kellner, 100 lb. of such straw, whilst for maintenance purposes equivalent to about 40 lb. of starch, will for fattening or other 'productive' purposes be equivalent to rather less than 20 lb. of starch.

The amount and composition of the *ash* of barley straw varies greatly with season, soil, manuring, and other factors, but, on the average, it contains about half its weight of silica, 20-25 per cent of potash (K_2O), 7 per cent of lime (CaO), 4 per cent of phosphoric acid (P_2O_5), and 2½ per cent of magnesia (MgO), the proportion of potash being, however, very variable. In other words, then, 1000 lb. of barley straw will, on the average, remove from the soil 5¼ lb. of nitrogen and 50 lb. of mineral matter, the latter including about 25 lb. of silica, 12 lb. potash, 3½ lb. lime, 2 lb. phosphoric acid, and 1 lb. of magnesia.

If reasonable allowance be made for losses in storage of manure, &c. (see Hall and Voelcker, Journ. Roy. Agr. Soc., vol. lxiii (1902), pp. 76-114), then the manure produced by the consumption of 1 ton of barley straw of the above composition should at the current unit prices of the three fundamental ingredients of manures (nitrogen = 12*s.*: phosphoric acid = 2*s.* 9*d*; potash = 3*s* 6*d.*) be worth about 7*s.* 6*d.* In the case of straw used as litter the value will, of course, be rather higher.

Barley straw is in general held in low repute for feeding purposes, partly owing to its poverty in nutriment, due to late cutting, and partly to practical difficulties arising in its application. It may be fed with safety to cattle and sheep, but is less suitable for horses than the straw of oats or wheat.

BARLEY GRAIN —Of the cereal grains, barley is surpassed in economic importance only by wheat

Bread and other preparations of barley formed at one time staple articles of the diet of the poorer classes, but, owing to the superiority and cheapness of the corresponding preparations of wheat and oats, very little is now utilized in this way. By far the greater portion of the barley crop is now used in the preparation of malt liquor and ardent spirits, only such grain as is of inferior value for this purpose being converted into 'pot' or 'pearl' barley, or used on the farm as food for stock. The barley grain contains a much lower proportion of husk than the oat, the average being only 10–11 per cent in good malting barleys, but rather higher in the coarser and thinner barleys Where the barley is grown for brewing purposes the aim is always to produce a grain poor in protein and rich in starch, the starch being further in such condition that it very readily undergoes the changes desired by the maltster and brewer This subject is discussed later. (See MALT) For the present it suffices to add that these qualities are usually found in plump, thin-skinned grain of medium size, showing decidedly mealy surfaces when cut, and with husk wrinkled and uniformly pale straw-yellow in colour - these being the outward characteristics of normally completed maturation of the grain. Such barley will almost always have a weight with normal moisture-content—of at least 54 lb per imperial bushel, or a weight of 40–50 gr. per 1000 corns Grain weighing less than 52½ lb per bushel will almost invariably be found to be either excessively moist, or small thin grain of low value to the brewer

Barley which is relatively rich in protein is usually considered as of inferior malting quality, but is not necessarily inferior for feeding purposes. The reverse will, indeed, very frequently be the case, since bad harvest conditions which so greatly lower the malting value of the grain have, as a rule, far less effect on its nutritive value. In composition and digestibility barley grain is, in general, intermediate between wheat and oats, being poorer in protein and more fibrous than the former, and richer in carbohydrates and less fibrous than the latter. The composition varies greatly, however, notably with climate and season, and to a less extent with the character of the soil and its cultural and manurial preparation for the crop.

The following averages given by Kellner (Die Ernahrung der landwirtschaftlichen Nutztiere, 4th ed., 1907) agree well with published analyses of British barleys:—

PERCENTAGE COMPOSITION.

	Average grain	Plump grain	Thin grain	Feeding barley.
Moisture	14·3	14·3	14·3	14·3
Crude protein	9·4	8·7	10·2	12·0
Ether extract	2·1	1·8	2·5	2·4
Nitrogen-free extractives	67·8	70 2	63·7	63·7
Crude fibre	3·9	2·7	6 5	5·0
Ash	2·5	2·3	2 8	2·6

According to Kellner, barleys of the above composition would for fattening, and probably for other 'productive' purposes, be equivalent to 72 0 lb, 75 8 lb., 66 4 lb, and 67·9 lb. of starch respectively.

The average digestibility of the grain by different classes of stock is given by Kellner as follows —

PERCENTAGE DIGESTIBILITY.

	Ruminants (mean of 4 experiments)	Horses (1 experiment)	Pigs (mean of 15 experiments)
Crude protein	70	80	75
Ether extract	89	42	49
Nitrogen-free extract	92	87	89
Crude fibre	?	(100)	12
Total organic matter	86	87	81

Apart from apparent differences in the digestibility of the fat, barley is obviously digested to pretty much the same extent by all classes of stock The 'albuminoid ratio' of grain of the above average composition and digestibility will be about 1 : 10

Fully 95 per cent of the total carbohydrate matter of barley is starch, and at least the same proportion of the nitrogenous matter is of true protein nature, comprising at least five distinct proteins (Osborne) According to Lintner there is also always present a diastatic ferment which exerts a powerful action on the starch, without, however, bringing it into solution

The *ash* of barley grain is fairly constant in amount and composition, containing, on the average, 35 per cent of phosphoric acid (P_2O_5), 25 per cent of potash (K_2O), 25 per cent of silica (SiO_2), 8½ per cent of magnesia (MgO), and 2½ per cent of lime (CaO) In other words, 1000 lb. of barley grain (say 18 bus.) will remove from the soil on the average 16 lb of nitrogen and 25 lb of mineral matter, the latter including about 8 lb phosphoric acid, 6½ lb. potash, 6 lb. silica, 2 lb magnesia, and ½ lb. of lime. Calculating on the same basis as in the case of barley straw, the manure produced by the consumption of 1 ton of barley of the above average composition should be worth about 14*s.*

Barley and barley products rank amongst the most valuable of farm foods, being especially valued in the feeding of swine and milch cattle.

The whole or roughly crushed grain is the staple food of horses in hot climates, but in the more northerly countries is regarded as decidedly inferior to oats owing to the facts, as demonstrated by Belgian experiments, that it has a greater tendency to 'heat' the animals, and to produce flabbiness, than to maintain the energy and endurance of the horse. It is, moreover, more liable to give rise to disturbance of the digestive organs, and therefore should probably not form more than one-quarter, or at the very most one-third, of the total grain food of the horse. Being a harder grain than oats, it should be fed in crushed or scalded condition and mixed with chaff to ensure thorough mastication.

When fed to other classes of stock the barley is usually ground to meal, or the offals obtained in the milling of the grain for the production of 'pot' and 'pearl' barley are used. This milling process consists essentially in the removal of the skin and husk of the grain, and gives rise to three grades of offals, viz. (1) coarse dust—the offal from the first process of 'blocking' the grain to remove the husk, (2) medium dust—a rather finer quality with less husk, and consisting practically of the inner skin of the grain, (3) pearl barley dust—obtained when the grain is milled down to a very small size, and forming a white flour practically free from husk and skin. The proportion of offal obtained from a given weight of grain naturally varies greatly, but amounts, perhaps, on the average, to roughly 40 per cent of the weight of the grain.

The value of the offals for feeding purposes will be determined largely by the proportion of husk present in them. In general they are rather richer in protein and crude fibre, and poorer in carbohydrates, than the whole grain. Adulteration is not common, the impurities most frequently met with being weed seeds, oat husk, and dirt—the last-named especially where the barleys are of foreign origin.

Barley meals and 'dusts' are to some extent given to milch cows, notably in Denmark, where a mixture of barley and oats forms the staple ration. It is claimed by many Swiss cheesemakers that the finer barley meals exert a favourable influence on the quality of the cheese made from the milk of cows consuming them. Barley in the form of meals and offals finds its widest application on the farm in pig-feeding. Danish and American experiments indicate that although barley meal is slightly inferior to maize in the amount of fattening increase produced by a given weight of meal, the quality of the produce is greatly superior to that obtained by feeding exclusively with maize. Indeed, barley is probably superior to any other single grain for the production of bacon of prime quality.

After wheat, barley is the best grain food for poultry. The use of barley grain in the fermentation industries supplies the farmer with three valuable foodstuffs, viz. brewers' and distillers' grains, malt, and malt dust. For further information as to the nature and use of these, see separate articles. [c. c.]

Barley, Statistics of.—The growing of barley is a distinctive feature of British agriculture, for although in common with other corn crops the surface devoted to this cereal is reduced in the last thirty years, the 1,885,000 ac. covered by this crop in 1907 is more than 22½ per cent of the land under corn in the United Kingdom. Elsewhere in Europe larger total areas may be grown, but not in equal proportion to this. Russia thus devotes a surface of over 20,000,000 ac. to barley, and furnishes the largest share of our imports; but even this great surface is a little under 11 per cent of the vast cereal area of that country. The barley acreage of Germany is more than twice our own, or some 4,000,000 ac., but the proportion this bears to her corn area is only the same as the Russian. The Austro-Hungarian empire is a large barley grower, and shows an area of 5,700,000 ac., representing 14 per cent of the corn land; a ratio which in the Austrian provinces taken by themselves rises as high as 17 per cent; but this is still below our own percentage. Agricultural statistics are not available for Turkey, whence considerable barley imports are received here; but Roumania, although a considerable contributor to our receipts of this cereal, has a smaller barley area than ourselves, and one representing about the same proportion of its corn area as in Germany or Russia. France, with over 33,000,000 ac. growing corn, puts more than a half of this under wheat, and only 1,764,000 ac. under barley, devoting thus little over 5 per cent of the corn land to this crop. Outside of European limits, however, her Algerian dependency grows barley on no less than 45 per cent of her corn area. Of other extra European barley-growing countries whence returns are available, the two largest are British India and the United States. In the former, 7,000,000 ac.—or about 6 per cent of the corn area—is thus occupied; and in the latter, where there has been a rapid extension of the barley area since the century began, the 6,324,000 ac. quoted for 1906 is only 3½ per cent of that carrying grain.

In an American official estimate published in 1893 an estimate was hazarded of the total production of barley in the civilized world at just over 100,000,000 qr., whereof Russia supplied one-fifth part, and the other European States collectively accounted for another three-fifths of the available supply. On the basis of acreage a somewhat similar proportion, or three-fourths of the whole, was at the same date credited to Europe by Sir Robert Giffen, in the statement published by the Royal Commission on Agriculture. For Asia, only Japan is, in these estimates, noted as a grower of barley, and both calculations omit British India, the produce of which does not appear to figure in the commercial supply. A later American return for 1905 raises the world's aggregate of barley to over 146,000,000 qr.—the Russian crop alone accounting for 42,000,000, and the United States, Austria-Hungary, and Germany being credited with 17,000,000 qr. each. Our own crops and those of Japan come next in magnitude, but represent only half these totals.

The yield of barley per acre in the United Kingdom stands high, Belgium with 48 bus. per acre, and Holland with over 46, alone surpassing our 33½ bus., while the acreages to which these higher estimates relate are extremely insignificant, and they are collectively inferior to that of the single county of Norfolk. If regard be had to the countries where alone the barley area approaches or exceeds our own, the contrast is in our favour. The German yield, indeed, is estimated on a five years' average at very little below 33 bus., but the Russian yield, even in the Polish provinces, hardly exceeds half our own, or 17 bus per acre, and in the other European governments of that empire it falls to 13 bus. The Austro-Hungarian yield averages 21½ bus. and that of France 22½, while in the United States the estimate does not much exceed 26 bus, a figure which is also said to be reached in Japan. The Algerian area already referred to as forming so large a percentage of the cereal growth is conspicuous for the inferiority of its yield, giving a return of little more than 11 bus per acre

The yield of barley varies, however, within the United Kingdom not only from year to year, but geographically to a considerable extent Three-fourths of the whole acreage lie in England alone, where the estimated decennial mean is a little below the yield of over 33 bus per acre credited to the kingdom as a whole In Wales, where the acreage is small, it is less than this, but in Scotland and Ireland more Omitting counties with insignificant areas of barley, Kent with over 38 bus to the acre, and Northumberland with nearly 36, are conspicuously good, while in Gloucester, Berkshire, Surrey, and Huntingdon decennial means below 30 bus are recorded. The small Welsh acreages vary widely in productivity from 40 bus in Anglesea to somewhat over 25 bus in Carmarthen. Only four Scotch counties grow more than 19,000 ac of barley, and Forfar with 39, and Fife and Berwick with 37 bus. stand highest of these. A yield of over 44 is indeed quoted for an area of nearly 5000 ac. in Midlothian, and one of nearly that figure for 2580 ac. in Linlithgow, while over 15,000 ac. in East Lothian, a decennial average of nearly 42 bus is reported. For the single year 1907 the official estimate exceeded the average, giving 35 7 bus. per acre for England as a whole, but only 34 1 in Scotland

As regards the contraction in the barley area of this country it may be noted that previous to the collection of official statistics the surface under this cereal was believed to have been extending in England but declining in Scotland and Ireland. The records of the last forty years have shown an increase between 1867 and the five-year period, 1876-80, carrying the United Kingdom total from 2,440,000 ac. to 2,750,000 ac., the English quota rising from 1,892,000 ac. to 2,100,000 ac., or three-fourths of the whole. At this maximum period, while England had 29 per cent of her corn area in barley, Wales had 30 per cent, and Scotland 19 per cent. The latest figures show a loss of a million acres of barley from the highest total for the United Kingdom, which was put at 2,931,000 ac. in 1879. The English barley acreage alone has declined from 2,236,000 ac. in that year to 1,411,000 ac. in 1907, but this still represents 26 per cent of the reduced surface under corn. In Wales a relatively greater decline is reported. In Scotland 210,000 ac. are still grown, compared with 218,000 ac in 1867 and 279,000 ac. in 1879. Nearly as much (202,000 ac) was grown in 1906 in one English county, that of Lincoln. That county, with Norfolk and Suffolk, accounts for half a million of the English 1,400,000 ac, and adding Yorkshire to this group it would seem that half the English area is accounted for.

The gross production of barley in the United Kingdom is now put at 8,400,000 qr. Roughly valued by the official average prices the crop was worth £10,000,000. The consumption of this cereal is very greatly in excess of the home produce, entailing considerable drafts on the production of other lands The imports were small until a period immediately following the Crimean War. From 1857 onwards till 1872 they ranged between 6 and 8 million cwt. Thereafter they averaged over 11 million for some years, and 15 million in the decade ending 1890 The later imports have been greater. A record importation of over 31 million cwt. occurred as long ago as 1894, and an average of over 20 million cwt has been maintained since, although in this interval the receipts have been occasionally as low as 17 million cwt and as high as 27 million. The trade returns of 1907 value the imports of the year at a sum of £6,565,000, a sum about two-thirds as great as the value of the home production Russia remains the largest source of our supplies of foreign barley, although in 1907 the quantity thence received, 6,346,000 cwt., is much less than in recent years as much as 12,237,000 cwt coming from that country in 1904, and 19,447,000 cwt. in 1894. The Roumanian and Turkish supplies are next in magnitude to the Russian, and the United States, although formerly importers of barley, have largely extended their area, and sent us nearly 3 million cwt. in each of the last two years

The course of barley prices can be traced in this country for 136 years, but it has to be remembered that the official averages of this grain always represent the mean of two widely varying classes of produce, from the high-quality barley in demand for malting to the lower grades employed for feeding. It is interesting that towards the end of the 18th century barley prices averaged 27*s.* 6*d.* per quarter over the years 1771-5, and fell below 18*s.* a quarter in 1780-1. Record prices of 59*s.* 10*d.* and 68*s.* 6*d.* were realized during the times when high quotations of all prices prevailed, as the 19th century opened. A quotation as low as 21*s.* 10*d.* was recorded in 1822, but thereafter prices were maintained well above 30*s.*, except for depressions in 1833-5, in 1842, and in 1850-2. From 1853 to 1885 only two annual averages of below 30*s* a quarter occur, and there were seven years when over 40*s.* was recorded. Since 1885 no 30*s.* quotation has appeared, the highest figure being 28*s.* 8*d.* in 1890, and the lowest 21*s.* 11*d.* in 1895. For the year 1907 the gazette prices for English markets mark a recovery to 25*s.* 1*d.*, and this is a higher barley price than the barley grower has got in recent years. [P. G. C.]

Barn, The.—The term 'barn' is a somewhat generic one. Literally it stands for a place in which barley is kept—from the Anglo-Saxon *bere*, barley, and *ærn*, a store. It now applies, however, to the building in which threshing operations take place, to the threshing floor itself, and to the other divisions of the building in which at one end sheaves are stored in readiness for being threshed, and at the other the threshed straw is piled up for use either as fodder or litter. Very often, too, an overhead loft in the barn does duty as granary. And the hay shed is sometimes spoken of as a Dutch barn. But the barn as we mean to deal with it is the building which contains on the ground floor accommodation for separating the grain from the straw, and for laying up a considerable store of the latter as well, and overhead has floorspace for the storage of grain and feedingstuff. This is almost the only building at the farm which properly admits of being two-storied. Where live stock are housed it is inadmissible to have a floor over their heads It is now considered better to light cattle-houses and stables through the roof than by the side walls This cannot be done by the former method when a ceiling intervenes Besides, ventilation, which is a more important matter, can be more easily controlled in a building that is clear to the roofing boards than in one where an overhead floor comes in the way

In order to be thoroughly available the barn must be of a large size Twelve or fourteen feet is not too high from floor to floor if a fair store of stuff is intended to be under cover at one time It should be capable of holding the sheaves of one stack at any rate in front of the threshing machine In fact, it ought to have storage room of this kind to deal with as much as will keep the mill going for a continuous spell of the mill 'hands'—be it half a day or a whole one This admits of the sheaves being taken to the barn at odd times that happen to be convenient, and of threshing being carried on irrespective of weather. And it goes without saying that the end of the building intended for the storage of straw must not be less than will enable it to hold straw in accordance with the accommodation afforded for sheaves. It must not be less, but it may safely be a great deal larger. The more floorspace that is yielded below, there will be all the more accommodation on the floor above. There will hardly ever be enough, however, for granary purposes proper. So much room is wanted nowadays for the preparation of food for the live stock, and this being the most suitable location for the purpose, it is clear that additional room will in many instances be required for grain storage. This it may be practicable to get overhead of some building ranged at right angles to the barn — one clear of live stock, the implement shed, for instance. A loft of this kind, although likely to be at a lower level than the upper floor of the barn, would be none the less quite convenient to it. The grain could be delivered thereon from the elevators as handily as on the principal floor.

Were it not that the position lends itself to convenience in the preparation of food for the cattle and horses, the straw barn might be left open to the framework of the roof. At this end of the upper floor of the barn range, however, it is very convenient to place the corn grinder, the corn bruiser, the cake crusher, and the hay and straw chopper Here corn is quite handy to the hopper both of grinder and bruiser, while the cake and straw and hay can be raised from below as required. The prepared stuff can be passed through shoots to 'lean-to' houses at the side of the barn—to the pulping house or to the steaming house on one side, and to the horses' quarters at the other.

The barn is, in short, the commissariat department of the modern farm homestead. On this account it is the central point of the buildings, and according as it is placed in relationship to the others will the easiness of working the place depend. To begin with, it should be in close touch with the stackyard But what is of more importance still, it must be both near and convenient to the byres and stables—to the places in which much straw is disposed of, and in which prepared food in addition to simple grain is dispensed. Placed in this way as regards these buildings, there is the minimum of labour concerned in conveying the stuffs mentioned from the barn and its accessories to the animals to be served

A good deal of horse labour is involved in carrying the sheaves from the stack to the threshing floor All this would be saved were sheaf sheds (see art SHEAF SHEDS) available at the homestead Then it would be quite practicable to run the sheaves from these by hand on a miniature railway or by overhead trolleys. Scarcity of labour will soon make contrivances of this sort a necessity at the homestead. With such available, girls or lads could do what men and horses have now to be set to accomplish. There is, as is well known, a great lack of ingenuity in the contrivance of labour-saving appliances at the farmsteading. When labour was plentiful there was not much call for anything of the kind. But now that circumstances have changed in this connection we do not see much sign of farmers or their advisers rising to the occasion. There is, we need hardly point out, as much room for improvement in these respects at the distributing end of the barn as at the receiving point.

Over and above the mechanical fittings of the barn (all of which fall within the province of the millwright), there are few that the builder of the place has to concern himself with. Wide doors running on wheels hung from above, and plenty of iron-framed windows with hopper openings to the outside (in order that dust may get out as well as light get in) well up towards the flooring joists, are a necessity on the ground-floor portion. And then the most suitable floor is one of Portland-cement concrete. This stands the tear and wear incidental to such places, and keeps rats in check. It may be necessary, however, to sheathe with boards the parts of the floor on which horses' feet and cart wheels are likely to bear. If the walls are of stone, a coat of cement plaster makes a good finish: if of brick, a neat point with cement is enough. On the top floor, the sides of the walls may be finished similarly to those of the granary (see art. GRANARY) Light is best obtained by means of skylights; and these, if hinged, can be opened at will, so that dust may find an exit, and the place at any time be flushed with fresh air. So much dust is generally about a place of this kind that it is worth while going to the small extra expense of planing all the woodwork of the roof that projects or shows downwards. Dust finds a less stable lodgment on a smooth surface of this kind than on one rough from the teeth of the saw. And ridge ventilators of a suitable kind are a necessity. See arts. VENTILATION, VENTILATORS, SHEAF SHED, GRANARY. [R. H.]

Barn-door Fowl.—The designation here given has been applied to the common fowls of any given district, though in older books the term 'dung-hill fowl' was more general. In French the name is *poule commune*, or common fowl, which means the same thing. The term is used to denote the ordinary type of fowl met with in any given district or country, produced without the adoption of arbitrary standards or by the selection of breeders. Observation made over a wide area shows that, as in the case of other classes of stock, the tendency is ever to the production of uniformity where the conditions of soil and climate are the same. It is in this direction that we find an explanation of the evolution of some of the different races of animals; and what is true with regard to horses, cattle, sheep, and pigs, is equally so in the case of poultry, modified by the influence of imported stock due to the migrations of man. The question is very fully discussed by Mr. Primrose M'Connell in his Agricultural Geology, in which it is shown that the uniformity found in races of animals over a wide area is due to the fact that the conditions are also uniform. Hence it is evident that what is known as natural selection, by a slow but steady process eliminates the exceptional and preserves the general type. Under these circumstances the barn-door fowl was produced, and it cannot be questioned that in many respects it had a very pronounced individuality, which was passed on from one generation to another, and the members of the various forms met with were really distinct breeds or varieties, in that they bred perfectly true, though perhaps not with the same exactitude as our modern and fixed races. In some cases the barn-door was the possessor of excellent economic qualities, perhaps not to the extent met with in some of our special egg-producing or table breeds, and almost without exception were hardy in the extreme.

With the introduction of other and foreign races, and the modifications resultant from artificial selection (see POULTRY BREEDING), the old barn-door fowl has practically become extinct in western Europe and in the more thickly populated sections of the New World and the Antipodes. Instead of the fowls met with in any district or country possessing the same characteristics, recognizable by reason of their similarity, evolved as a result of the local conditions and the play of selection on the part of the birds themselves, as a rule there are great differences not merely in primary but in secondary characters; or if, as in some few instances, the fowls of the district are fairly uniform, that is due to deliberate selection on the part of breeders, in which case the type is more defined and pronounced. As these conditions apply universally to our own country and also to others, the modern meaning of the term 'barn-door' fowl, or *poule commune*, is, that the birds so designated are mongrels, or so mixed that they have no individuality. Hence the preference expressed by some people for barn-door fowls has no justification at all. [E. B.]

Barn Machinery and Utensils.—The great improvement made in threshing machines during the past quarter of a century has materially lightened the work of cleaning corn, consequently barn machinery is not used so much; still, a well-prepared sample is more attractive, and always pays for reasonable trouble in its preparation. The comparatively dry harvests of the past twenty years have made harvesting easy, and there has been little grown corn to handle, whereas in the previous few years grown kernels were very frequent. In the preparation of corn for market, the taking out of grown kernels is of chief importance, because in wheat the flour from grown grain will not rise, and grown kernels of barley cannot malt again, but become mouldy, giving a musty smell to samples of malt. The cleaning of samples is mainly effected by sieving or by wind separation. For some years there has been a tendency to separate more by the sieve than by wind. Although separation by size is useful when treating whole grain, it is not so with grown grain, which has a lighter specific gravity. We think that should a series of wet harvests visit us again, the old type of machine made by Cooch, in which wind is largely depended upon, would be more favoured. The modern type introduced by Baker, through the use of wire screens in the place of perforated zinc, gets a bigger sifting area in a given surface, and a relatively smaller and lower machine is obtained, and this has proved an attraction to purchasers. Whichever type is used, it is necessary to have sufficient change sieves to suit the nature of the seed to be treated. In districts such as Bedfordshire, Kent, and Essex, where all corn crops are grown, and where in addition much clover seed - red, white, and alsike - as well as turnip seeds are grown, it is necessary to have sieves which will suit any size between a bean and alsike.

No machine grades a sample better than Boby's screen, where a series of fine rods (capable of regulation) are placed parallel in a frame, down which the corn passes from a hopper. The frame has a reciprocatory motion, and in its passage down the smaller grains fall through the open spaces, being assisted (and the grain being prevented from lodging) by series of coffers placed on rods running across the frame. In barley cleaning they are specially valuable. Rotary screens, where the separation is practically on the same principle, are also very good. Messrs. Boby have a machine for taking out broken grains, also of special value for malting barley. This consists of a revolving drum, placed somewhat vertical: the drum is indented with holes not sufficiently large to hold a whole kernel; but as it revolves, the smaller pieces are held up in the depressions, and lifted higher than the whole grains; the broken grains ultimately fall inwards, being caught on a receiver inside the drum, and are carried away. An ingenious and highly effective clover-seed cleaner was awarded the silver medal of the R.A.S.E at the 1907 show, and is undoubtedly a great advance on any machine previously brought out It was invented by Dossor, of Doncaster It consists of a frame carrying a hopper, which feeds on to two plush-lined belts running in opposite directions. As the seed gravitates and is forced downwards by the lower belt, it is raked by the plush, and rough seeds and particles are swept over the upper edge The partly cleaned seed falls into a small hopper, thence on to another set of running plush belts and is further cleaned; and so on through a dozen of such sets, coming out ultimately most perfectly cleaned It is capable of being set to suit all kinds of clover seeds, and one man can clean from 15 cwt. to a ton of seed in a day. See Winnowing Machines.

The Hand Sieve.—The cleaning which corn gets in the modern threshing machine makes hand-sifting practically unnecessary, though where small quantities of corn are threshed by hand for seed purposes, they are occasionally useful; but the complete set of sieves used when the flail was in common use are not required except for special work. The most useful hand sieve is one which will take off the coarser heavy material which comes from the top sieve, such as thistle heads, sticks, grain still surrounded by chaff, which is often in considerable quantity when corn is damp when threshed, &c. The stoutest and boldest corn often passes with this, and from this show samples are often selected It is an important principle in cleaning grain to pass rather more corn on to the sieve than the sieve will conveniently carry; then rubbish which if left an undue period on the sieve might find a way through with the cleaned portion, is carried off as toppings. This entails the carrying off of some sound grain, and occasions rather more hand-sifting, and the passing again through the machine of the sound grain extracted by the hand sieve; but it ensures the thorough cleaning of the grain. See Sieves.

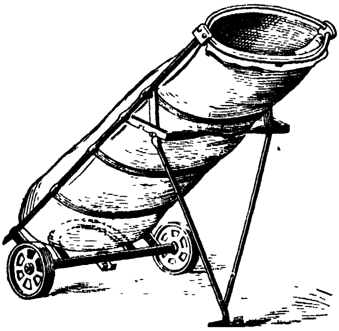
For filling the hopper of the winnower, a wicker basket, wooden trug or tray, pail, or other suitable vessel is necessary. It should be light, easily filled, and convenient to lift, as from 8 to 10 qr. should be placed in the machine in an hour.

Barn Shovel.—Shovels for shifting grain or seed should be large with raised sides, and deep at the back, capable of holding a peck of grain. See Shovels.

Brushes of whalebone or birch brooms are needed for sweeping up, and sweeping should be well maintained, or much grain is likely to be crushed by the feet of the workmen. When corn was generally threshed by the flail, it was customary to find the workmen in barn slippers to prevent crushing. See Brushes.

Flail is little used, except to thresh small quantities of corn; though many farmers prefer to have their seed beans and peas threshed by the flail, as it is less likely to split and spoil the growing powers of the grain than when threshed by the ordinary threshing machine. See Flail.

Measures.—The imperial bushel is the standard measure for grain, though many districts still adhere to a local measure, in which a bushel grain varies considerably in weight and bulk from the standard. The bushel measure should be of convenient shape to be readily emptied into an ordinary corn sack. Half-bushel measures, peck measures, and pottle measures are convenient and almost necessary.



Combined Sack-holder and Barrow

Sacks.—The ordinary corn sack should hold 4 bus. conveniently. In the corn trade an allowance of 4 lb. is expected per sack. Thus grain sold at 18 st. per sack is weighed up at 18 st. 4 lb. Dealers supplying their own sacks commonly supply them of light material, and so gain an extra 2 lb. of corn per sack. In the seed trade a 5-bushel sack is ordinarily used, and an allowance of 5 lb. is expected, and is claimed if a 4-bushel sack is used See Sacks.

Weights.—The old custom of selling by measure independently of weight has practically died out within recent years. Dead-weight sack-weighing machines are largely used, but platform weighers are increasingly employed now.

Hummellers.—The efficiency of hummellers attached to threshing machines has practically done away with the need for hand hummellers. Where used they consist of a number of straight blunt blades about a foot long, set on a frame parallel and vertical, an inch or more apart. These are attached to a long handle, and hummelling is performed by repeatedly chopping into a layer of grain laid upon the floor. They are most used for chopping off the awns of barley. Rotary hummellers are sometimes used, the blades being attached to a drum-like frame which is wheeled over the grain.

STRIKE.—The strike is a flat straight-edged board, or a circular roller, used to strike off grain which lies above the top of the bushel measure and so leave the grain level all over, and consequently a proper measure. It is not needed where grain is sold by weight.

Sack-holders of different types are made to hold sacks conveniently while being filled, and unless a man is skilled in filling from a measure tend to save labour; while when filling with a shovel they do so to a greater extent. Combined with a sack barrow they are very useful.

[W. J. M.]

Barn Owl (*Strix flammea*).—This is the commonest of our native owls, and is a permanent resident. It is a comparatively large bird of about 13 in. long, with light tawny plumage, while the 'owl' face and sharp talons are characteristic of its group The bird, like its kind generally, has been the cause of many superstitious ideas, and various groundless charges have been brought against it, *e.g.* that it destroys game. Fortunately, however, it no longer has to suffer the relentless persecution that was for so long its fate. The nocturnal habits and noiseless flight of the Barn Owl are matters of common knowledge, but it is not so well known that, like owls in general, it ejects the indigestible parts of its food from the mouth in the form of rounded masses called 'pellets' or 'castings', which serve as an important clue to the nature of the food. There is no nest, and the white eggs (up to seven in number) are laid in convenient holes in ruined buildings, barns, rocks, and hollow trees· incubation begins when two have been deposited.

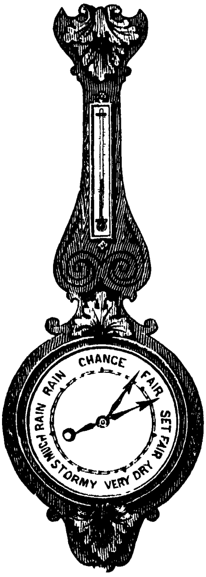
Barn Owl (*Strix flammea*) and Nest

The food of the Barn Owl is entirely of animal nature, chiefly consisting of mice, voles, rats, and other pests, to which may be added shrews, moles, bats, small birds, and occasionally fresh-water fishes. Seebohm describes a case where no less than twenty freshly killed rats were found in one nest, and he took the trouble of sorting the contents of 700 pellets, which gave the following mortality table.—16 bats, 2513 mice, a mole, and 22 birds (19 being sparrows).

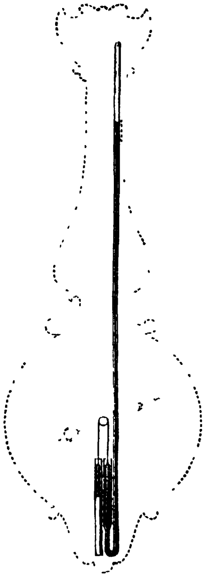
There can be no doubt that the Barn Owl is one of the best friends of the farmer and cultivators in general Where voles increase unduly its services are invaluable. All that can justly be urged against it is that the shrews and bats which it devours are themselves destroyers of pests And it is true that it has been known to take young game-birds which have been hand-reared, though by keeping these in coops at night the danger is easily avoided. The wild young are efficiently protected by the hen-birds.

During the close season, March 1 (or in some counties February 1) to July 31, a penalty of £1 (under the Wild Birds' Protection Act) can be exacted, most justly, for taking or killing a Barn Owl, and in some localities there is local legislation for protection of its eggs. In cases like this, the craze of 'egg-collecting', generally a useless and unscientific pursuit, deserves the severest reprehension. [J. R. A. D.]

Barometer is an instrument used for measuring the pressure of the atmosphere. It was not shown conclusively until the year 1643 that the atmosphere possessed weight, although it was suspected long before that time. In that year Torricelli, an Italian, demonstrated it in a simple experiment. He filled a strong glass tube about 3 ft in length, with a narrow bore and sealed at one end, with mercury. He closed the open end with his finger, and then inverted the tube, holding it vertically over a small dish filled with mercury, the open end being submerged in the liquid metal. On removing his finger, but keeping the end still under the mercury, he found that some of the mercury flowed out of the tube into the dish and left a column in the tube about 30 in. in height. From this he inferred that the weight of the atmosphere pressing down upon the mercury in the vessel was sufficient to support the column of mercury in the tube to the height at which it stood, and that the weight of mercury in the tube was equal to the pressure of the atmosphere at its base. As the tube was full of mercury to start with, the space left between the top of the mercury column and the hermetically sealed end of the tube must be an empty one, except for a little vapour of mercury. This empty space or vacuum is called a Torricellian vacuum, and prevents any pressure being exerted on that end of the mercury column by the atmosphere. Perrier in 1648 showed that the atmospheric pressure became less the higher you got from sea level, and later, by finding the rate at which this pressure diminishes according to the distance from sea level, Boyle suggested the use of a barometer for measuring the height of mountains. As the volume of a gas is inversely proportional to the pressure, the temperature being constant, the density of air must diminish the higher you get from sea level, and it follows that the pressure must be correspondingly less. The greatest pressure is at sea level, and that represents the weight of air immediately above, and of that extending to the extreme boundary of the atmosphere. The average height of the barometer at sea level in Great Britain is 29·95 in., which is equal to a pressure of 14·75 lb. per sq. in., but through various causes the pressure of the atmosphere at a given point is continually varying. As the pressure becomes less the mercury falls in the tube—as it increases the mercury rises or is pushed up the tube. Mercury is 13·5 times heavier than water, hence the atmosphere would support a column of water 13 5 times higher than that of mercury — that is, about 32 ft. This height represents the distance through which the pressure of the atmosphere enables water to be raised by an ordinary lift pump.



Wheel Barometer
Exterior



Internal Structure
of same

There are three types of mercury barometers in use, namely, (1) cistern; (2) syphon; and (3) wheel barometers (see figure). Self-recording barometers are also constructed.

The glass tubes used in making barometers are about 33 in. in length, and about ⅓ of in. in diameter, having a thick wall and a uniform bore. They are filled with pure redistilled mercury. After the tube is filled and inverted, a scale is fixed so as to mark the height of the mercury column: The column seldom varies in length outside 31 and 28 in. respectively.

In accurately recording the atmospheric pressure from the barometer readings, several *corrections* are necessary:—

1. Temperature must be taken by the thermometer that is always attached to a good barometer, because the column of mercury and the glass tube behave like most other bodies, that is, they expand on warming, and contract on cooling; hence the length of a column of mercury will be affected by temperature, so in order to get concordant readings from two barometers in different localities a correction must be made either for expansion or contraction due to temperature. The readings are all reduced to a standard temperature, namely, 32° F. Many barometers have a table attached for making this necessary correction.

2 For error in the scale of the instrument, and for capillarity, tables showing these corrections can be obtained with the instrument.

3. The readings should all be reduced to sea level It has already been pointed out that the pressure of the atmosphere varies with the height from sea level; hence it would be impossible to compare accurately the readings of two barometers situated at different levels, unless the readings were first reduced to that of sea level. This correction can readily be made from a printed scale supplied with the barometer.

The readings of a barometer supply valuable information upon the weather conditions; hence the explanation of the following weather points often made on a barometer—stormy, much rain, rain, changeable, fair, settled, very dry. These readings, taken in conjunction with other meteorological records, make it possible to arrive at tolerably good forecasts of the weather. Such forecasts are issued to the daily papers by the meteorological office. For a portable barometer, see ANEROID BAROMETER. [R. A. B.]

Barred Plymouth Rock. See PLYMOUTH ROCK FOWL.

Barrel Churn. See CHURNS.

Barrel Pulper. See PULPERS, ROOT.

Barrenness.—When the female fails to conceive, she is said to be barren. In the mare, cow, and bitch, barrenness is due to a variety of causes It may result from imperfect development of the ovary; tumours of the ovary; fatty degeneration of the ovary in very fat, pampered animals; catarrh of the womb; irritable condition of the womb, with profuse secretion, and straining; nervous irritability; high condition; low condition, with lack of sexual desire; poor feeding, overwork, and chronic debilitating diseases; closure of the neck of the womb, either temporarily or permanently; acquired indisposition to breed, seen in old and hard-worked mares which are first put to the stallion when aged; change of climate; hybridity, which in male and female alike usually entails sterility.

Treatment —The treatment varies with the cause. In the mare a diseased and irritable ovary ought to be removed. An irritable womb, with frequent straining, and the ejection of a profuse secretion, may sometimes be corrected by a restricted diet, and full but well-regulated work. Even fatigue will act beneficially in some such cases; hence the practice of the Arab riding his mare to almost exhaustion before service. The perspiration in such a case, like the action of a purgative, benefits by rendering the blood vessels less full, by lessening secretion in the womb and elsewhere, and thus counteracting the tendency to ejection and loss of the male element. Low condition and anæmia demand just the opposite kind of treatment—rich, nourishing, albuminoid food, bitter tonics, sunshine, gentle exercise, liberal grooming, and supporting treatment generally.

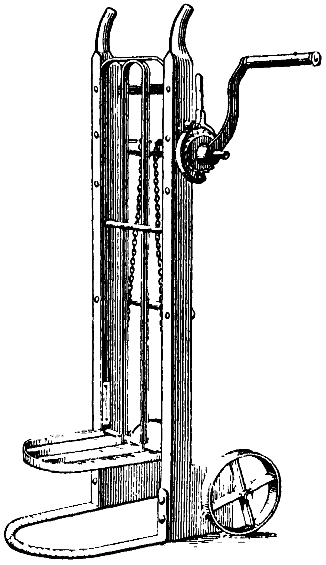
Spasmodic closure of the neck of the womb is common, and is easily remedied in the mare by dilatation with the fingers. The hand, smeared with belladonna ointment and with the fingers drawn in to the form of a cone, is introduced through the vagina until the projecting rounded neck of the womb is felt at its anterior end. This is opened by the careful insertion of one finger at a time, until the fingers have been passed through the constricted neck into the open cavity of the womb. The introduction is made with a gentle rotary motion, and all precipitate violence is avoided, as abrasion or other cause of irritation is likely to interfere with the animal becoming fertilized. If the neck of the womb is rigid and unyielding—a rare condition in the mare, though common in the cow—more force will be requisite, and it may be necessary to incise the neck to the depth of about one-sixth inch, in four or more opposite directions prior to forcible dilatation. This, however, is an operation which requires the skill of a veterinarian, and indeed he ought to be consulted in all cases of sterility. As artificial insemination is now largely practised in the mare and cow, and with a large measure of success, a female should not be declared barren unless, having tried every other remedy, the animal fails to conceive when inseminated by the hand of man and in the proper manner. [H. L.]

Barrenness of Soils. See INFERTILITY

Barrows.—Wheelbarrows have many uses on the farm, and are convenient where a cart cannot be readily worked, as in cow byres. In fen districts they are used to wheel out clay dug from below the peaty soil, so that it may make a soil of better consistency and prevent its being blown away, as occurs on 'blowing' fens. On soils overlying chalk, the chalk is often dug up from shafts or dene holes, and spread about the surface, and the handbarrow is here also found more economical than the horse and cart. Formerly barrows were made exclusively of wood except for the tyre, but now metal barrows are used frequently. A barrow required for moving heavy earth requires to have the wheel more under the body than one used for moving manure or light material.

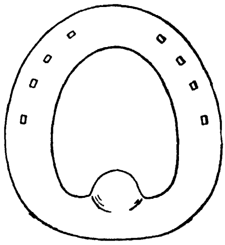
The sack barrow is a necessity where there is much corn to be moved in the sack. Where there is much sack carrying to be done, a barrow with a sack raiser in the form of a windlass and raising bottom saves time and trouble, and is especially useful about a homestead where at times there is only one man about, who would find it practically impossible to raise a full sack from the ground and get it on to his back.

The seed barrow is a hand-propelled distributor, usually used for sowing small seeds, such as clover, grass, mustard, &c., broadcast. It is 12 ft. or more in width, and the box is fitted with a long spindle carrying pinion brushes to force the seed through perforations. Somewhat similar barrows have been made to distribute concentrated manures; but the sowing in this case is effected by imparting a reciprocating motion to a flat bar at the bottom of the box, which opens and shuts holes to regulate the flow, giving a sort of pepper-caster action. [W. J. M.]



Sack lifting Barrow

Bar Shoe, a horseshoe with the heels united by a transverse bar. A variety of bar shoes are made, some of them nearly round or ovoid. Their object is to enable the frog to take some share of the weight of the animal, which is not usual with the rim of iron ending at the heel on either side. It relieves the crust of some share of weight. Pressure can be distributed so as to relieve a sand crack (see SAND CRACK) or a corn, or enable a hoof disposed to spread to support a horse which would be otherwise lame. It relieves those suffering from ring-bone and side-bone. For weak heels and a variety of foot defects and malformations the bar shoe is most valuable, and will be referred to particularly under diseases of the foot. [H. L.]



Bar Shoe

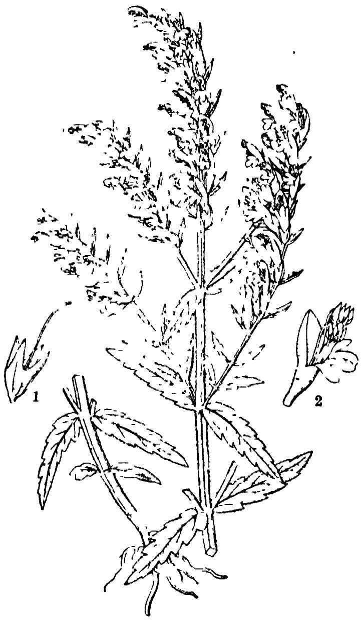
Barter.—By 'barter' is meant the direct exchange of goods without the intervention of money or substitutes for money. It is the mode of trade in the most primitive stage of society. From this stage, society develops when some article or articles are bought not for themselves but to be sold again. A commodity treated in this way is being used as money. Many kinds of commodities have served the purpose. People were impelled into a money economy by the great inconveniences of barter. Some of these have been aptly described as consisting in the implied double coincidence of wants. A person who wants to exchange goods has to discover somebody who not only needs what he (the seller) has, but also has what he the seller wants. Again, there is the great disadvantage that market prices cannot emerge. The price of an article can only be expressed in the separate ratios at which it exchanges against the hundreds of different articles with which it is bought. This being so, sellers and buyers get little guidance as to the demands and supply prices of other people. Higgling consequently is of great importance, and much time is wasted in this way. It is only by such a tedious process of bargaining that buyers can assure themselves that they are not paying much more than is necessary. The immense amount of time wasted in effecting purchases in primitive markets but little removed from the barter stage has frequently been the subject of remark.

The theory of barter is not unlike the theory of international trade. Each throws considerable light on the other. International trade reduces, when stripped of its non-essential trappings, to the exchange of exports (commodities) for imports (commodities) Generally speaking, the final rate of exchange between two commodities reached by two bartering persons is determined by the exchange values which each sets upon different quantities of the other's goods The more each gets of the goods of the other the less he will give for additional supplies, because he values these additional supplies less and treasures more his own goods of which he is depriving himself. Thus each offers less and less favourable terms. Let the barterers be A and B, and A possess apples and B nuts. If A begins by tendering an apple for a nut he will not take six nuts for six apples, but will require a higher price in nuts B, too, raises the price of his nuts in apples when big quantities of each article are involved. Starting at opposite poles, in respect of the favourableness of the terms upon which they will do business, the persons bartering are finally driven into a position in which the terms they propose are identical. This is the position of equilibrium. Each is just satisfied, and neither is prepared to enlarge or diminish the quantity of the deal at the ratio of exchange implied. Observe that if the trade starts with a number of small transactions, the ultimate rate of exchange is affected by the rate at which these took place. He who is put at a disadvantage in the first exchanges, winning only an insignificant share of the gain which the trade implies, is left finally in a position less advantageous than that which he might have occupied had he looked more carefully after his interests from the outset.

The enormous inconveniences of barter show how important is a sound system of currency which enjoys full public confidence. Doubt as to the value of money—as, for instance, when it is debased or an inconvertible paper currency—drives people back from the money-economy to bartering-economy. This means a most disastrous check on progress, because when exchanging is so difficult, the specialization of labour, which necessitates more buying and selling, is discouraged. More than once in the history of nations this almost irreparable hurt has been sustained. It is only a money-economy which will lead a community from the system of largely self-supporting family groups to the complicated social unity where each depends on the labour of hundreds of others and is enabled to choose his tasks to suit his powers.

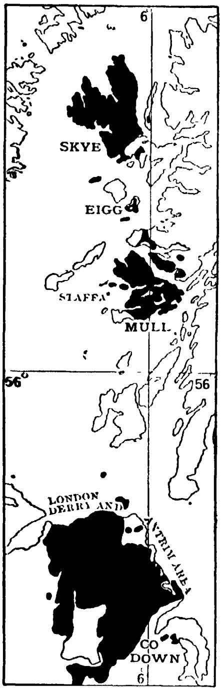
[s. j. c.]

Bartsia (*Bartsia Odontites*).—This is a common downy annual weed belonging to the Foxglove family (Scrophulariaceæ) which is often found in the cornfield and by the roadside. It is a diminutive plant about 9 in. high. The stems bear narrow leaves with toothed margins and one-sided clusters of inconspicuous dull-purple flowers. Bartsia is peculiar in its mode of life; on the one hand, it is an ordinary green plant manufacturing its food by the carbon assimilation process, but on the other it is a robber and a parasite, inserting suckers into the root of any suitable plant which it finds in its neighbourhood. Its object is to extract therefrom what nutriment it can. The technical name for this mode of life is Partial Root Parasitism, and the term is appropriate not only to Bartsia, but to a whole group of allied plants



Bartsia (*Bartsia Odontites*) 1, Calyx; 2, corolla of the same family, such as Yellow Rattle and Eyebright. All these partial root parasites turn black in drying, and this is a useful mark for identifying such plants in hay. [A. N. M'A.]

Basalt.—An igneous rock of minutely crystalline structure, with some glassy matter, containing 40 to 55 per cent of silica, about 4 per cent of alkalis (soda predominating over potash), and about 10 per cent of lime, 4 to 10 per cent of magnesia, and 13 per cent of iron oxides. The rock is comparatively rich in phosphoric acid. Typical basalt is dark-grey or black, distinctly heavy (sp. gr. 2·9), and consists of lime-soda or lime-felspar, a pyroxene (usually augite), olivine, and magnetite or titaniferous iron ore. Exceptionally, where potash is a prominent constituent, leucite occurs, as in the modern lavas of Vesuvius.



Map of Lava Area in British Isles

Basalt occurs in dykes, sheets, or surface lava-flows. The dykes often stand out like walls above the surface of otherwise arable lands, and the rock, from the vegetation left upon it, is popularly known as 'whinstone'. Though occasionally an obstacle to farming, these dykes, when freshly quarried into, supply one of the very best road-metals. Basalt lava-flows, owing to their comparative fluidity, spread far from the spot where they are extruded, obliterating, as one succeeds another, the former features of the landscape. The plains and terraces of Upper Cretaceous lava in western India, extending over 200,000 sq miles, and the volcanic region of Idaho, Oregon, and Washington, of equal magnitude, illustrate the very broad areas that may be deluged with basaltic lavas. In our own islands, large parts of northern and western Mull, the whole north of Skye, and the interior of Co. Antrim and the east of Londonderry, are covered with similar lavas.

When subject to prolonged weathering, a basaltic country becomes worn into a series of plateau-terraces, formed along the surfaces of united and overlapping lava-flows, with cliffs between them, which arise from the decay of the rock along its vertical joints At the foot of these brown cliffs, heaps of detritus gather, and break up into a soil. This structure of plateaus and steps (*trappean structure*, from Swedish *trappa*, a staircase) formerly caused all dark lavas to be classed together as *trap rocks* or *traps*. Typical trappean structure is seen in the west of Mull, and throughout Trotternish in Skye Good grass grows, and cattle are fed, on the broad terraces and tables, and here and there lakelets and bogs gather in the hollows of the surface. The islets off the coast repeat the same monotonous terraced structure. The small crofts and thin oat-crops characteristic of these areas in the Inner Hebrides are connected with climatic and geographical features, and not with any poverty of the soil. The basalt lands of Antrim, notably those between Ballymena and Belfast, are among the most successfully tilled in our islands, and furnish a model to all other parts of Ireland. Even when modified by the presence of glacial drifts, the soils here owe much of their fertility to the included detritus from the underlying basalt.

The main shrinkage-joints of basalt often split the rock into regular columns, like those of Staffa, and a tendency to form curved joints within the boundaries of the main ones is apparent. Weathering, operating on these secondary joint surfaces, breaks the mass up into spheroids, with concentric coats like those of an onion. Hence basalt decays easily, a process aided by the rusting of its iron compounds, and its joints become coloured brown or orange. The *soil* formed is a loam, brown or red through ferric oxide, with residual lumps of the lava in it, the finer portions breaking down into a ferruginous clay. Zeolites have often formed in the steam-hollows of the basalt, and these, being more easily attacked than the felspars, afford a means by which alkalis and lime may be made available in the soil. The lime-content is in all cases of value, and the magnesia derived from the decay of the pyroxene, olivine, and the allied constituents, may also be serviceable, in the form of a carbonate, as a base for neutralizing the acids produced by bacterial action in the soil A basalt subsoil will be always ready to supply lime, magnesia, and phosphoric acid to the soil above it, and the soil on the leucite basalts of Vesuvius contains a supply of potash immensely superior to that of granite soils. The dark colour of basaltic soil renders it warm, and cultivation can be carried on in consequence high on basalt slopes (Risler, Géol. agric., i, 1884, p. 125). The famous pasture-lands of Auvergne and the Cantal in central France depend on the basalts that have been there poured out over the older rocks. Some of the more recent flows are still rugged on the surface, and are given over to woodland; but wherever the red soil proclaims their decomposition, grass grows richly, in marked contrast to that on the granites and schists that form the mass of the central plateau. On the borders of the Rhine valley, and notably in Sicily, basalt soils have been found admirable for vine culture.

[G. A. J. C.]

Base is the term given to a substance which has the property of neutralizing acids, forming salts. It is synonymous with the term 'alkali'.

When a base is added to an acid the characteristic property of the acid is destroyed, and a point is reached when the solution containing the two substances gives neither an acid nor an alkaline reaction, but a neutral one. At that stage sufficient base has been added to combine with all the acid present, and a normal salt is formed

The substances included under the term 'base' are (1) Oxides and hydroxides of metals, and sometimes metals themselves, (2) ammonia and its derivatives, (3) organic bases. One of the characters of metallic elements is that they form oxides capable of neutralizing acids, forming salts, such oxides are termed basic. On the other hand, many of the non-metallic elements form oxides which dissolve in water, producing acids; such oxides are called acid-forming Some of the principal non-metallic elements possessing this property are sulphur, nitrogen, carbon, phosphorus, and chlorine

An example of a metal acting as a base would be the action of zinc upon sulphuric acid.

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sulphuric acid}}{H_2SO_4} = \underset{\text{Zinc sulphate}}{ZnSO_4} + \underset{\text{Hydrogen}}{H_2}$$

Metals, such as iron, mercury, copper, lead, tin, calcium, aluminium, sodium, potassium, magnesium, &c, all form salts with acids In doing so the metal takes the place of the hydrogen of the acid, as seen in the above equation.

The action of quicklime (oxide of calcium) upon sulphuric acid may be taken as an example of the neutralizing powers of a basic oxide.

$$\underset{\text{Quicklime}}{CaO} + \underset{\text{Sulphuric acid}}{H_2SO_4} = \underset{\text{Sulphate of calcium}}{CaSO_4} + \underset{\text{Water}}{H_2O}$$

In this case the hydrogen of the acid is given off in combination with the oxygen of the base as water.

When a basic oxide combines with water the compound formed is called a hydroxide.

$$\text{Thus} \quad \underset{\text{Quicklime}}{CaO} + \underset{\text{Water}}{H_2O} = \underset{\substack{\text{Calcium hydroxide} \\ \text{(slaked lime)}}}{Ca(OH)_2}.$$

$$\underset{\text{Sodium oxide}}{Na_2O} + \underset{\text{Water}}{H_2O} = \underset{\text{Caustic soda}}{2NaOH}.$$

The neutralizing powers of a hydroxide may be represented thus:

$$\underset{\text{Slaked lime}}{Ca(OH)_2} + \underset{\text{Sulphuric acid}}{H_2SO_4} = \underset{\text{Sulphate of calcium}}{CaSO_4} + \underset{\text{Water}}{2H_2O}.$$

Many of the basic oxides are very caustic, and dissolve in water, with which they combine, forming strongly alkaline solutions. Such solutions turn the red colouring matter litmus blue. Quicklime is used extensively in agriculture because of its powerful basic properties; it becomes less caustic when it combines with water, forming the hydroxide. Magnesia (oxide of magnesium) is also a strong base, but remains caustic much longer than quicklime when exposed to air, because it takes up water more slowly than quicklime to form the hydroxide. Both calcium and magnesium hydroxide, when left exposed, combine with the carbonic acid gas in the atmosphere and form a carbonate, which is a neutral salt. The caustic properties of basic oxides have an injurious action upon growing plants, hence it is always safer to apply them agriculturally in the form of hydroxides, that is slaked. Oxides and hydroxides of the alkali metals, of which sodium and potassium are the principal, are called alkalis (see ALKALIS) Ammonia is a very powerful base, and combines with acids, forming salts called ammonium salts

Just as it was found that strong and weak acids exist, so in the same sense it may be said that strong and weak bases exist also. A strong base will partly replace a weak one from its combination with an acid The salts of the stronger bases are more stable than those of the weaker. When ammonia is added to a solution of iron sulphate, the iron is replaced and deposits out as the hydroxide and ammonium sulphate is formed Similarly, when quicklime is added to ammonium sulphate, ammonia is replaced and given off as a gas, and calcium sulphate is formed Thus ammonia is more basic than iron, and calcium is more basic than ammonia

The organic bases include highly complex bodies, and occur largely in vegetable and animal substances For information regarding them the reader must consult a book on organic chemistry [R. A. B.]

Basic Slag is a by-product obtained in the manufacture of steel from ores containing phosphorus. A great many of the ores of iron contain some phosphate. When the ore is smelted the phosphorus passes almost entirely into the pig iron Formerly pig iron which contained more than a very small quantity of phosphorus could not be used for manufacturing steel by the Bessemer process, as the presence of the phosphorus rendered the metal 'cold-short', that is, liable to crack when bent or hammered below red heat. This limited the iron which could be used for making Bessemer steel practically to that which had been prepared from hæmatite. A change took place when the late Mr. S. G. Thomas, in collaboration with his cousin Mr. P. C. Gilchrist, patented in 1878 a process 'for the manufacture of Bessemer steel from phosphoretic pig iron'. This is known as the Thomas-Gilchrist process or basic Bessemer process, and the slag which is obtained from it is known as Thomas slag or basic slag This slag was at first a waste product, which was allowed to accumulate about the steel works. But its value soon became known, and it is now one of the most largely used phosphatic manures. The basic process had a most important effect in extending the manufacture and use of steel by rendering available for steel-making ores rich in phosphate. The output of steel and of slag from this process has consequently grown to enormous proportions.

MANUFACTURE OF BASIC SLAG.—The phosphoretic pig iron is treated in large crucibles, known as converters, which are lined with bricks made largely of lime A large amount of lime is also added to the molten iron in the converter A strong blast of air is blown through the molten metal and burns off certain of its impurities, including the silicon, which passes into the slag as silicate, and the carbon, which passes off as oxides. This raises the molten mass to a bright white heat, and the phosphorus is oxidized and combines with the lime; at the same time the silicon present, which has been oxidized to silica, combines with lime to form silicate. Silicate and phosphate of lime form the main part of the slag, which is poured off from the surface of the molten metal. The slag is a hard, heavy, dark substance, the grinding of which at first caused much difficulty But suitable steel-ball mills have now been produced which grind the slag to a very fine powder Slag is now usually sold on the understanding that it is so finely ground that at least 80 per cent will pass a standard sieve which has nearly 10,000 holes per square inch This sieve should be made of the wire gauze No 100 E of Amandus Kahl.

COMPOSITION OF BASIC SLAG --Basic slag, which is also known as Thomas slag, Thomas phosphate, Thomas phosphate powder, slag phosphate, and similar names, varies much in composition. The percentage of phosphate which it contains varies with the amount originally present in the pig iron and with the details of manufacture. Usually the phosphate, estimated as tribasic phosphate of lime, varies from about 20 to about 40 per cent, this is equivalent to phosphoric acid from about 9 to about 18 per cent, but samples are not uncommon which contain phosphate either above or below these limits. In addition to the phosphate a small amount of phosphorus in the form of phosphide of iron exists in basic slag. This is slowly oxidized in the soil to phosphate.

The principal constituents of basic slag are as follows —

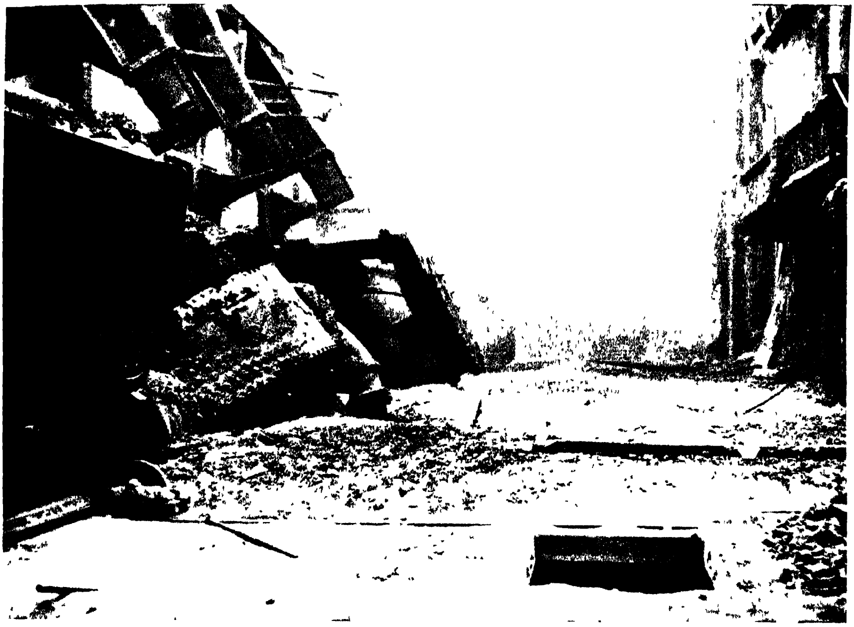
Phosphoric acid	8 to 20 per cent
Silica	5 ,, 15 ,,
Sulphuric acid	0·2 ,, 1 ,,
Lime	35 ,, 55 ,,
Ferrous and ferric oxides	10 ,, 20 ,,
Alumina	1 ,, 8 ,,
Magnesia	2 ,, 8 ,,

The phosphate of slag is in combination with lime. In the early days of its production it was supposed that the phosphate was not in a form available for the use of plants, and that the ferrous compounds present would be injurious in the soil. Attempts were made to utilize the slag by dissolving out the phosphate, but these were not successful. It was not till it was discovered that the phosphate is combined with lime in a form in which it is soluble in ammonium citrate or dilute citric acid, and even in carbonic acid, and that it is only necessary to grind the slag finely to render it available for the use of plants, that it came into extensive use as a manure. The phosphate in slag differs from that in mineral phosphates of lime, such as coprolites and phosphorites, and is more readily dissolved. It consists mainly of a basic calcium phosphate, $Ca_4P_2O_9$, known as tetra-calcium phosphate This phosphate resembles dicalcium phosphate, which is the phosphate of precipitated phosphate and basic superphosphate, rather than tricalcium phosphate, the phosphate found in bones and mineral phosphates, in its solubility.

Recent investigations have shown that the silicate in basic slag has also a connection with the solubility of the phosphate. It is found that the phosphate in those slags which are rich in silicate is more soluble in reagents, and more available to plants than that in slags poor in silicate, no matter how rich they are in lime. It has also been found that slags of low solubility can be rendered more soluble by fusing them along with silica. It is probable, therefore, that, at any rate to a certain extent, the phosphate in slag is present in combination with silicate as a double salt, and that such double salts are more soluble and available than tricalcium phosphate.

The lime in slag is nearly all present in combination with phosphoric and silicic acids It is sometimes stated that basic slag contains a considerable percentage of free lime A fresh sample of slag certainly has an alkaline reaction, and readily causes the liberation of ammonia from ammonium salts. Direct determinations of the lime present as a free base, however, show that only a very small percentage, say 2 per cent or less, is ordinarily present Probably a considerable amount of lime is loosely combined either in basic phosphate or in double salts of phosphoric and silicic acids, and is readily liberated and rendered available as a base under suitable conditions In good samples of slag, by far the greater part of the phosphate present can be dissolved by a dilute solution of citric acid. This method of testing the solubility of slag is now generally adopted, and it is customary for sellers to guarantee the phosphate soluble in citric acid as well as the total phosphate in slag The solubility in citric acid varies to a certain extent with the strength of the acid and the method of extraction A standard method has therefore to be followed The method generally adopted in all countries for determining the citric solubility of slag is known as Wagner's method, after the well-known German chemist, Dr Paul Wagner of Darmstadt, who has done so much to determine the properties and value of slag. In this method, which has long been in use on the Continent and has been adopted as the official international method, the slag is shaken with a 2-per-cent solution of citric acid, in the proportion of 1 gr. of slag to 100 c c of solution, for half an hour. A similar method has recently been adopted by the Board of Agriculture under the Fertilizers and Feeding Stuffs Act, and is practically the only officially recognized method of agricultural analysis at present adopted in this country. The availability of slag and its value as a manure largely depends on its citric solubility, and it is just as important that it should be sold on its content of citric-soluble phosphate as it is that superphosphate should be sold on its content of water-soluble phosphate. Farmers in purchasing slag should always obtain a guarantee of its citric solubility in the invoice. Ninety per cent or more of the total

MANUFACTURE OF BASIC SLAG



THE "BLOW." AIR UNDER PRESSURE BEING FORCED THROUGH THE MOLTEN METAL IN THE CONVERTER

A SLAG HEAP. A "BALL" OF BASIC SLAG ABOUT TO BE TIPPED phosphate of a good sample of slag will be citric-soluble.

Production and Consumption of Basic Slag.—The value of basic slag was first recognized in Germany. Field experiments with it were started about 1882, and in 1883 about 5000 tons were used. The consumption rapidly increased, as shown in the following table, which gives the estimated consumption of basic slag for the whole world —

In 1885	150,000 tons
,, 1890	420,000 ,,
,, 1895	845,000 ,,
,, 1900	1,760,000 ,,
,, 1905	2,300,000 ,,

In 1906 it is estimated that 2,383,000 tons were produced as follows:—

Germany	1,510,000 tons
United Kingdom	300,000 ,,
France	235,000 ,,
Belgium	250,000 ,,
Austria-Hungary	65,000 ,,
Russia	18,000 ,,
America	5,000 ,,

It is estimated that in the same year 2,412,000 tons were consumed, of which about 1,300,000 tons were used in Germany and 167,000 tons in the United Kingdom Other large consumers are France, Belgium, and Austria.

The above figures show how rapidly the manufacture and use of basic slag have grown to enormous proportions. It is now one of the most important and largely used phosphatic manures in the world. Germany was not only the first country to realize the importance and value of basic slag, but continues by far its largest producer and consumer. The basic process of steel-making was a British process, and was first carried out in England, but it has benefited the German steel industry much more than the British, and is much more extensively carried out in Germany than in England

Value and Use as Manure.—When it was first introduced, many agricultural chemists were very doubtful of the value of basic slag. It was held that the phosphate could not possibly be more available than that in mineral phosphates, and was probably less available on account of the association of the phosphate with so much iron. This prejudice was only slowly broken down. The German workers who first took up the subject showed that weight for weight the phosphoric acid in slag was from one-half to two-thirds as effective as the water-soluble phosphate in superphosphate during the first year, but that during subsequent years the slag phosphate was quite as effective as the superphosphate. The water-soluble phosphate of superphosphate may be looked upon as the most active form of phosphate But when washed into the soil it gradually becomes reverted by the lime, iron, and alumina of the soil into insoluble forms. On the other hand, the phosphate of slag is combined with excess of lime, and does not become converted in the soil into a more insoluble form. Therefore while under average conditions water-soluble phosphate appears to be more available than slag phosphate at first, after a time the manurial residues of the two manures become of somewhat similar availability.

Under ordinary market conditions slag phosphate is considerably cheaper per unit of phosphate than superphosphate. Roughly speaking, during recent years it has cost the farmer about two-thirds to three-fourths of the price of the same amount of phosphate in superphosphate. Therefore a larger amount of phosphate can be obtained for the same money in the form of basic slag than in the form of superphosphate. While it has not the quickness of action of soluble phosphate, under many conditions when equal money values of phosphate in the two forms are applied the basic slag produces as great a return as superphosphate even in the first season. Thus, on the average of fifteen experiments on turnips conducted under the auspices of the Aberdeen and North of Scotland College of Agriculture, the following results were obtained (Bulletin No. 4, 1906).—

No manure	9 tons 5 cwt.
Sulphate of ammonia Superphosphate Sulphate of potash	20 ,, 5 ,,
Sulphate of ammonia Basic slag Sulphate of potash	20 ,, 4 ,,

On both the manured plots, sulphate of ammonia was applied in such quantity as to supply 20 lb. nitrogen per acre, and sulphate of potash so as to supply 40 lb. potash per acre The superphosphate used supplied 100 lb. phosphoric acid per acre, and the basic slag was used in such quantity as to cost approximately the same as the superphosphate It will be seen that the average results are practically identical.

On the other hand, when equal quantities of phosphoric acid are used upon the turnip crop in the forms of water-soluble phosphate and slag phosphate, on the average the water-soluble phosphate will give the greater return. The following figures, which illustrate this, are taken from the experimental results of the Agricultural Department of the Glasgow and West of Scotland Technical College (Reports for 1893, 1894, and 1895):—

	1893 Average of 12 Experiments		1894. Average of 15 Experiments		1895 Average of 34 Experiments		Average of 3 Years	
	tons	cwt	tons	cwt	tons	cwt	tons	cwt
No manure	16	12	12	12	8	9	12	11
Superphosphate	24	14	18	9	15	4	19	9
Basic slag	22	8	18	1	14	1	18	3
Bone meal	22	2	16	15	12	17	17	5

No dung and no other artificial manures besides those shown were applied to the plots included in the above table The superphosphate was applied at the rate of 6 cwt. per acre, and the basic slag and bone meal were applied in such quantities as to give the same amount of phosphoric acid per acre. It will be seen that in every season the superphosphate gives a bigger average return than the basic slag, which in turn gives a bigger return than the bone meal. The bone meals used were ordinary commercial articles and were not specially finely ground. In spite of the fact that they supplied some nitrogen as well as phosphate, they proved to be less effective manures each season than either basic slag or superphosphate.

The turnip crop is one particularly well adapted to illustrate the value and availability of phosphatic manures, as it depends more upon a supply of available phosphate than upon any other manurial constituent, and in the absence of a plentiful supply of available phosphate little or no crop is obtained. Very numerous experiments have therefore been made upon the turnip, including the swede, crop with basic slag and superphosphate. The above illustrations are fairly typical of the results obtained throughout the country. It is found that generally speaking superphosphate causes a more rapid growth of the plants in their early stages, and brings them more rapidly to the hoe than basic slag or any other manure, but that in the later stages there is little difference. If the season is a cool damp one with a prolonged growing period in autumn, slag will give as great or nearly as great an increase in crop as superphosphate for equal weights of phosphoric acid used.

It has sometimes been suggested that as slag is a slower acting manure than superphosphate it should be applied earlier. A number of experiments have been carried out with the turnip crop in which basic slag has been applied broadcast in winter and compared with the same weight of slag applied in the drills in spring. Generally speaking, it has been found that it is better to apply the manure in the drills in spring. This is to be expected. Even if anything were gained by the slag decomposing in the soil and becoming more available to plants through early application, this advantage would be neutralized by the fact that placing the manure in the drills brings it into close proximity to the roots of the young plants, and they at once come into contact with it and draw upon it for the phosphoric acid which is so necessary for the rapid development of the turnip in its early stages.

While basic slag is a most useful manure for all soils, it was early recognized that it is particularly well adapted for application to certain classes of soils, and especially to peaty or moorish soils. While superphosphate is an acid manure and tends to use up and neutralize some of the supply of lime available as a base in the soil, slag is an alkaline manure and adds a certain amount of available lime to the soil. Hence basic slag is particularly suited for soils deficient in lime and with a tendency to sourness, as it helps to cure the sourness. The organic substances also, the presence of which renders peaty soil sour, help in their decomposition to dissolve the phosphate of the slag and render it available to plants.

Basic slag is very frequently used on soils on which the turnip crop is liable to be attacked by the much-dreaded disease finger-and-toe. This disease is favoured by any sourness of the soil, hence where it is prevalent sour manures like superphosphate are avoided and the alkaline basic slag used in preference.

Another class of soils on which basic slag is very extensively used, especially on the Continent, is very light sandy soils. In such soils there is not as a rule sufficient lime present to readily precipitate and fix as reverted phosphate the soluble phosphate of superphosphate. A portion of the phosphate is therefore liable to be washed away and lost, or to be washed so deeply into the soil as not to be readily available to the roots of plants. As the phosphate of basic slag is not soluble it is not in danger of being washed away, and has been found particularly suitable for very light sandy soils.

The feeding quality of roots grown with basic slag has been the subject of a considerable amount of investigation It is a not uncommon belief, in certain districts at any rate, that roots grown with slag are not of such good feeding quality as those grown with other manures. Sometimes it is said that such roots cause scouring and other troubles among cattle The results of experiments do not give any ground for these peculiar beliefs.

Recently several series of experiments have been conducted by the West of Scotland Agricultural College, in which turnips manured with basic slag were compared, as to chemical composition and feeding value for sheep, with turnips manured with superphosphate. The feeding value was measured by actually feeding the roots to sheep and determining the increase in live weight. In every case the results were favourable to the slag-manured turnips. Little difference was found in chemical composition between the differently manured roots, but when they were fed to sheep those manured with slag produced a bigger increase in live weight than an equal weight of the roots manured with superphosphate. Somewhat similar experiments were carried out under the auspices of the Aberdeen and North of Scotland College of Agriculture, in which the roots were fed to cattle instead of sheep. In these experiments no distinct difference was found in the feeding quality of the roots manured with these two rival manures.

One of the greatest uses of basic slag in this country is for application to poor exhausted pastures, especially on clay soils deficient in phosphoric acid and lime. The best-known experiment of this kind was that carried out at Cockle Park, the experimental farm of the Northumberland County Council. In this experiment very remarkable results were obtained by the use of basic slag, which turned almost worthless pastures, covered with a thin herbage of bent grass and weak, struggling, white clover, into a rich valuable grazing covered with white clover and good grass. It is only on certain exhausted clay soils that similar results can be obtained, and on most other poor soils slag alone gives a much less remarkable result than at Cockle Park, and in some cases little or no result at all.

During the past few years very numerous

experiments have been carried out in all parts of the country to test the effect of slag upon poor pastures of all varieties. For instance, the Highland and Agricultural Society, working in co-operation with the West of Scotland Agricultural College and the Board of Agriculture, carried out a series of such experiments which extended over seven years. In these experiments slag gave better results than any of the other manures tried, and in most cases effected marked improvement in the pasture to which it was applied. This improvement consisted not only in increasing the amount of herbage, but was just as marked in the quality of the herbage The amount of leguminous herbage was increased and the quality of the grass was improved. In some cases the changes took place only very slowly, and were not fully felt till three or four years after the manure was applied (see Transactions of the Highland and Agricultural Society, 1908, p. 269) The effect of slag is partly due to the lime which it contains, and sometimes it is said that it is due rather to the lime than to the phosphate. This statement does not receive much support from experimental results. Both lime itself and lime and superphosphate have been applied to poor grasslands in comparison with slag. In all cases the slag produced a much better result than lime alone. The combination of superphosphate and lime has produced very good results in many cases, but the results are seldom so good as those given by slag alone, and are not so economically obtained.

In improving poor pastures on soils deficient in potash, it is necessary to use a potash manure such as kainit, or potash salt along with slag. The use of a potash manure is necessary on many light sandy soils.

Basic slag is often mixed with other manures for application to crops such as turnips. In making such mixtures it is necessary to bear in mind that it should not be mixed with sulphate of ammonia. If this mixture be made the lime of the slag will liberate ammonia, which will be dissipated as gas Similarly slag should not be mixed with guano or dung or any manure which contains compounds of ammonia. If it be mixed with superphosphate or any dissolved phosphate the soluble phosphate will be 'reverted', that is, turned wholly or partly into insoluble dicalcium phosphate. On the other hand, it may quite safely be mixed with nitrate of soda, and with all the potash manures. [J. H.]

Basic Superphosphate.—Basic superphosphate is prepared by adding slaked lime to ordinary superphosphate till the mixture is distinctly alkaline. This substance was patented by Mr. J. Hughes in 1900. It is claimed by the patentee 'as a special phosphatic fertilizer for land which is either deficient in lime or contains an excessive quantity of organic vegetable matter'.

Ordinary superphosphate is an acid manure. Nearly the whole of the phosphate which it contains is soluble in water (see art. SUPERPHOSPHATE). But soluble phosphate of lime is necessarily acid in reaction. It has long been known that superphosphate does not act well on certain soils, especially on light soils very deficient in lime, or on black peaty soils with a tendency to sourness. It is also blamed for promoting finger-and-toe in turnips on land which is deficient in lime. Basic superphosphate is claimed to be an improved form of superphosphate manure, capable of being applied with advantage to those soils on which ordinary superphosphate does not produce good effects, especially with the turnip crop, on account of its acidity.

In order to remove the acidity of superphosphate it is necessary to remove the solubility of its phosphate in water. This is done in the case of basic superphosphate, the phosphate of which is insoluble in water. The whole advantage of superphosphate over other phosphatic manures lies in its solubility. This enables it to be washed into the surface soil in solution. It does not remain soluble, but is precipitated in the soil by lime and other bases which are present. But this solution and precipitation ensures very perfect distribution of the phosphate throughout the surface soil. This advantage is lost in basic superphosphate. On the other hand, basic superphosphate is very soluble in dilute acids. Its phosphate is almost entirely soluble in $\frac{1}{10}$-per-cent solution of citric acid. It is therefore a readily available phosphate. In it we probably have the phosphate in the most highly available condition possible short of solubility in water.

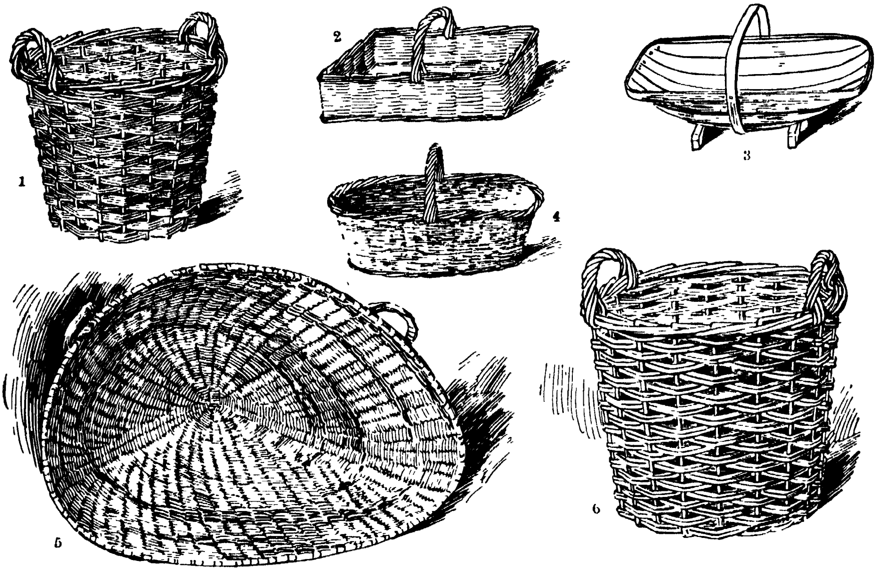
Such manurial experiments as have been carried out with basic superphosphate support its claim to be a highly available, quick-acting phosphatic manure. On the average its action is weight for weight of phosphoric acid very little behind that of superphosphate, and on sour soils and soils deficient in lime it appears to surpass superphosphate.

There are certain objections which are urged against it. In order to manufacture basic superphosphate it is first necessary to make ordinary superphosphate, and then to compound it with slaked lime. Basic superphosphate is therefore necessarily dearer per unit of phosphate than ordinary superphosphate, which in turn is considerably dearer per unit than highly available insoluble phosphates like basic slag and steamed bone flour. If therefore the farmer finds that ordinary superphosphate does not suit his land, he can obtain more cheaply other available insoluble phosphates, such as basic slag and bone flour, which are suited to soils which are sour or deficient in lime. It is also open to him to lime his soil and afterwards to use superphosphate. Basic superphosphate is an interesting attempt to get rid of the disadvantages of the acidity of superphosphate while retaining its availability and quickness of action, but unless it can be put on the market at a price per unit of phosphate not very different from that at which somewhat similar phosphate can be purchased in other substances, it is not likely to come into extensive use. [J. H.]

Basket-making. See OSIERS.

Baskets.—Baskets are used for many purposes, vary very much according to the fancy of the locality, and are mostly made of willow. Among the most common are:—Butter baskets of willow, generally oblong, flat, and with handle. Chaff baskets or skeps, made to carry 6 to 8 bus. of chaff from the chaff cutter, or to fodder cattle; sometimes they are smaller, even to carry only a bushel of food. Egg baskets, very similar to butter baskets, but generally much narrower at the top than the bottom; sometimes made of light wood. Fans of close cane work, made very similar in shape to the half shell of a mussel, are less used than when corn was threshed by the flail. They are very convenient for carrying chaff to fodder animals in open yards. Potato baskets are usually made to hold a bushel, and are used for many purposes. Potato seeding baskets are often made of willow, circular, and with wooden handle; sometimes circular and sometimes more oval. Poultry baskets or crates are made flat and oblong; sometimes with wattle, and sometimes only of stout openwork. Wooden baskets or trugs are much more common in some districts than are wicker baskets. They are made to hold 2 or 3 bus down to a quarter of a bushel, according to the purpose for which they are needed.

[W. J. M.]



Some Typical Forms of Baskets

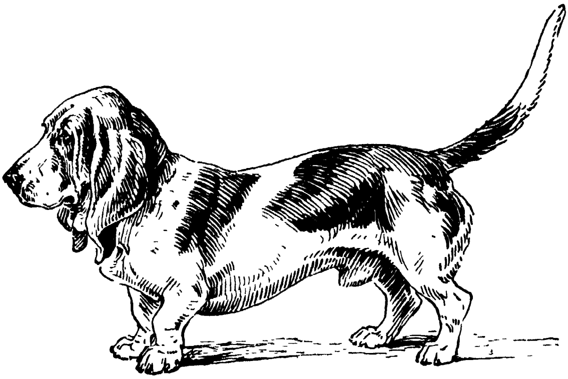
1, Bushel Potato Skep, 2, Butter Basket, 3, Trug, 4, Egg Basket, 5, Chaff Fan, 6, Large Chaff Skep

Basset Hound, The.—This quaintly shaped variety of hound, which in the eyes of the uninitiated very closely resembles the overgrown Dachshund, is a French variety, and undoubtedly closely allied to the Chien d'Artois Its introduction into England and the popularity which it enjoys are unquestionably in a very great measure due to the efforts of the late Sir Everett Millais and the late Mr. George R Krehl, who about 1880 was persistent in his advocacy of the merits of the breed.

So far as England is concerned it can scarcely be said that the Basset Hound has proved as useful to sportsmen as he is in his native land, as beyond being utilized for the purposes of drag-hunting, his services have not been applied to any field sports whatever; but in France it is quite a different matter. There, owing to the different conditions under which shooting is carried out, and the number of varieties of fourfooted game which exist, the Basset Hound is invaluable to the hunter, as his nose is quite exceptionally good; whilst his short, contorted limbs render it impossible for him to go too fast for pedestrians to keep up with. Hence the value of the assistance he renders when wounded animals have to be tracked.

The antiquity of the Basset Hound is as undeniable as is the esteem in which his merits are regarded by French hunters and sportsmen of the highest rank, amongst whom two breeds are recognized—the smooth-coated and the rough-coated, or Bassets Griffons. These again are subdivided into three varieties, namely, the crooked-legged, the semi-crooked-legged, and the straight-legged. The last of these is not often met with, and is very little appreciated, neither are the half-crooked-legged specimens thought so much of as those with decidedly contorted front legs The appreciation of the latter is not so much a matter of looks as of utility, for, as observed above, the crooked legs impede the rate at which the hound can move, and hence the hunters on foot are the better able to keep them in view when they are tracking a wounded animal.

Excepting for his limbs the Basset Hound is not very much unlike our English Harrier, as his head is decidedly houndy in character, and he carries his stern in quite the orthodox style. His high-peaked skull and beautifully chiselled muzzle are amongst his chief attractions; whilst the fact that his ears are left as nature made them, it not being the custom to round them, adds immeasurably to the beauty and dignity of his appearance. The neck of the Basset Hound is fairly long and rather powerful-looking, his body being heavily built and of considerable length, well ribbed up at the loins and deep behind the forearms. The stern, which is inclined to be coarse, is carried upwards like that of a foxhound, and his muscular development is extreme; whilst the front legs of the full-crooked variety are so extremely short that the breast bone in some cases almost appears as though it would touch the ground when the animal walks.


Basset Hound

The formation of the legs, and especially of the front ones, is, however, the chief characteristic of this peculiar-looking though valuable breed—so far, at all events, as the crooked-legged family is concerned. In addition to being of abnormally massive proportions, the front legs are very much out at the shoulder, which formation alone would seriously impede the progress of the animal. They are, moreover, so much in-turned at the pasterns that they almost touch each other, whilst the feet turn outwards to an extent that suggests the impression that the dog is a helpless cripple; but he is nothing of the sort, for considering the disabilities under which he labours, the Basset Hound is a very active dog, as those who have followed him drag-hunting will readily admit. The feet are abnormally large and are usually splayed, which makes them appear still larger, the front ones showing this formation to a greater extent than those behind. The back legs are very short, extremely straight at the hocks, and muscular about the thighs; whilst the jackets of the short-coated breed are rather harsh to the touch, and of a good weather-resisting texture. In colour the breed is principally white, relieved by the usual hound markings of black and rich tan, but many otherwise good specimens are to be met with which are almost entirely white, whilst others show no black at all, though the absence of markings naturally constitutes a fault from an exhibition point of view. The average weight of the breed is about 50 lb., but of course the dogs scale heavier than the bitch hounds.

The rough-coated variety differs but little from the smooth in structural development, though possibly the appearance of the head is less refined-looking, the larger amount of hair it carries being no doubt accountable for this. The colour of these hounds is a grizzly grey, and they present a very picturesque, workmanlike appearance, the harsh texture of their jackets likewise suggesting that they must be impervious to the effects of any kind of weather, no matter how severe it may be. The rough-coated specimens of the breed, however, are not nearly so popular in this country as in France, but still they possess many very influential supporters here. [v. s.]

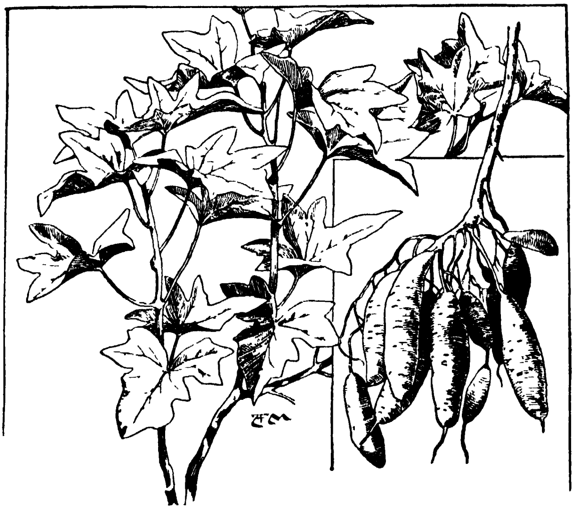
Bastard Fallows. — A bastard fallow, or, as it is called in some districts, a half fallow, is one which is taken in the latter part of summer on land which has carried a crop fed off or taken off in the early part of summer. The great increase in catch-cropping, and the disregard for the strict rotations which were insisted upon generally up to a quarter of a century or less ago, have brought bastard fallows into greater vogue. The value and necessity for dead fallows or whole fallows are not appreciated as they formerly were, and far less land is put under dead fallowing, the cleaning and aerating of the soil being accomplished by the bastard fallow. In this way a crop is taken where much soluble plant food would be wasted, and valuable catch crops are provided for the live stock. Even on heavy land the tillage effects of a bastard and a dead fallow are not necessarily greatly different, as it is not advisable to break up such land until the spring frosts are past, otherwise instead of keeping the land in large blocks it falls down to a fine tilth, and 'killing couch in the clod' is not possible; so that in a showery summer there is not much chance of the fallowing cleaning the land. A bastard fallow after catch crops, single cut clover or seeds, or other crop cleared before the corn harvest, carried on through the hot months, including June and September, loses little that is gained by the dead fallow, and it is consistent with the best husbandry and the most economical working of the land. See art. FALLOW. [W. J. M.]

Bast Mats. — These are made from the inner bark of the lime tree (*Tilia europæa*), large quantities of them being imported from Russia, the principal source of supply, the best quality being from Archangel. They are used in gardens for many purposes: shading, shelter from wind, protection from frost, packing, tying, &c. Many years ago they were in great demand for tying purposes, but the softer Raphia or Roffia, made from the leaves of a palm that grows in Madagascar and tropical Africa, is now generally used instead of bast. The Crimean war interfered with the supply of Russian mats for garden purposes, but a substitute was found then in a similar material made from the bark of a West Indian tree (*Paritium elatum*), and known commercially as Cuba Bast. This is still used for tying up real Havana cigars in bundles. [W. W.]

Basuto Ponies.—These are a small but very hardy race of ponies extensively bred in the rugged hilly country of Basutoland, from which they take their name. Their progenitors were brought from Batavia by the Dutch in the 18th century, and the stock has been renewed from time to time by fresh importations from the same source. As the result of crossing with Arab stallions, the breed has been much improved within recent years

Occasionally by legitimate transfer, more often by theft, large numbers of these ponies gradually passed from the possession of the Boer colonists into the hands of the aboriginal inhabitants of the country, a people possessed of a fair degree of intelligence and skill in agricultural pursuits. To its treatment at the hands of these natives, no less than to the physical configuration of the country, the special characteristics of the Basuto pony are largely to be attributed. Naturally endowed with a sturdy frame, the strength and hardiness of this little animal has been further ensured by the circumstances of his upbringing. He has been allowed to forage for himself among the rough herbage of the hills, and to suffer from partial starvation when that has failed, and thus by a process of natural selection the weaker animals have been weeded out, while only the stronger have survived in a form reduced in size but increased in hardiness, strength, and activity. Their habitual employment as animals of burden over the precipitous foothills of Basutoland has also conduced to this end, while it has made them remarkably surefooted. So much were these characteristics in evidence in the Basuto war, and in the Boer war of 1899–1902, that these small ponies were a subject of constant marvel to the British troops, by whom they were largely employed.

The Basuto pony is of a small size, good specimens standing from 14 to 14½ hands at the withers. The colours are variable, but black is seldom seen. Bays are perhaps commonest, and greys are much in favour. They are gentle and docile ponies, free from vice, and they make excellent polo ponies. They are also regarded as very suitable riding ponies for ladies.



The Sweet Potato Plant and Roots

Batatas, or **Sweet Potato.**—The Sweet Potato has no affinity with the ordinary potato of our gardens, but is a plant belonging to the nat. ord. Convolvulaceæ, the botanical name being *Ipomœa Batatas*, Lam. (sometimes *Convolvulus Batatas*, L., or *Batatas edulis*, Choisy). The native Haytian name *batatas*, by which the plant was known when first obtained by the Spaniards, was corrupted into *potato* and transferred to the ordinary potato, *Solanum tuberosum*, which is often spoken of as the Irish potato in parts where both are grown. The Sweet Potato was brought into England from Spain and used here before the ordinary tuber, and in references to the potato in Shakespeare and other early writers the former plant is usually intended.

The plant has trailing stems 5 or 6 ft. long, with heart-shaped or lobed leaves, and clusters of purplish, red, or white flowers similar to those of the hedge Convolvulus. Adventitious roots spring from the nodes of the stem and enter the ground, where they become tuberous, like those of the main root system. The root tubers are long and spindle-shaped, from 3 to 10 lb. in weight, and contain from 10 to 15 per cent of starch and 3 to 10 per cent of sugar. They form a very important part of the food of the inhabitants of many countries within the tropics, especially in the West Indies and other areas of the American continent. They are also much cultivated in China, Japan, and India, and are also grown in North Africa, Madeira, and the Canary Islands. Immature and damaged tubers are fed to stock sometimes, and the young stems and leaves make excellent fodder for horses and cattle. Several varieties are known, the two most common kinds having white and red tubers respectively. For proper development the sweet potato needs a warm climate and a light friable soil rich in humus.

Propagation is generally carried on by means of stem cuttings. These are about 1 ft. long, and are buried about 6 in. in the ground when planted. They are grown in rows 2 to 3 ft. apart, about 1 ft. asunder in the row, and are ridged or earthed up, as in ordinary potato culture. It is very necessary to keep the ground free from weeds in the early stages of growth by hoeing; afterwards the spreading stems cover the ground and check weeds. The crop is ready for lifting in three or four months after planting. Rooted shoots for early propagation are sometimes obtained from slices of the tuberous roots planted out in warm prepared beds. In the tropics the roots do not keep well, and are generally consumed soon after lifting; they are, however, sometimes stored in dry sand or in specially constructed pits or 'clamps' in subtropical districts. The yield is from 5 to 10 tons per acre.

[J. P.]

Bates, Thomas.—A talented and successful breeder, whose individual influence played an important part in the development of Shorthorn cattle. The story of his career must ever have a great fascination for the admirer of the breed, while it is well calculated to evoke the enthusiasm and encourage the emulation of the beginner in the engrossing pursuit of stock-breeding.

Born in 1775 at Aydon Castle, in the valley of the Tyne near Newcastle, Bates commenced farming at the age of twenty-five on the farm and estate of Halton Castle, in the neighbourhood of his birthplace. Here for a time he contented himself with the comparatively safe practice of grazing and feeding West Highland cattle. But it cannot be doubted that even while he pursued the beaten track, his active and intelligent mind was ever on the alert for a fresh outlet for his energies.

He had not long to wait for an opportunity of testing his skill. The dawn of the 'wonderful' century had witnessed a rapid improvement in the Shorthorn breed, and the possibility of a still greater advance was eagerly considered by young Bates. His periodical visits to Darlington Fair brought him into contact with the throng of noted breeders who at that time composed the court and parliament of the Shorthorn world. Among these were the Joblings, the Collings, Mason of Chilton, and the elder Booth, with all of whom Bates was on terms of friendly intimacy.

His early attempts at founding a herd were much circumscribed by inadequate financial resources, but fortunately a substantial legacy left him by an aunt enabled him to adopt bolder tactics. From this point onwards his record as a breeder, and his exemplary perseverance in the fixing of the famous 'Duchess' strain, form one of the most interesting chapters in the history of the Shorthorn breed, while the success of his efforts is abundantly attested by the unparalleled prices realized by the descendants of his herd. See art. SHORTHORN CATTLE.

But the life of Thomas Bates was not destined to be wholly narrowed down to the more or less prosaic sphere of activity which by the age of thirty-five he had established for himself. Ambitious promptings and a desire to widen the horizon of his knowledge led him to Edinburgh University, where he was enrolled as a student in 1810. His studies there embraced not only agriculture, but mental and moral philosophy. Of his lectures he took copious notes, which have been preserved, and which show him to have been a diligent student. After his return to Halton he busied himself with various feeding and other experiments, and it was then that he began to pay very particular attention to the milking capacity of the cows in his herd. He conducted extensive experiments to determine the relation between quantity and quality of milk and butter, and on the relative merits of the systems of soiling and grazing, and in a memorable address to the Board of Agriculture made a strenuous plea for extended experimentation of this kind.

His affairs continued to prosper, and in 1811 he purchased a small property of 1000 ac., forming part of the manor of Kirklevington, in Yorkshire, and some time afterwards he added to his real estate the lands of Ridley Hall, near South Tyne, whither he removed in 1821. He removed to his Kirklevington property in 1830, and dwelt there for the remainder of his life. Here he pursued the even tenour of his life till in midsummer 1849 he passed quietly to rest, and was buried in the little churchyard at Kirklevington. His herd was dispersed by public sale the year after his death

Bates was a man of great ability and of notable character. He was strongly self-reliant, and very firm and even stubborn in his opinions. In the show yard he was considered to be somewhat too insistent on his own views, which led him not infrequently into unpleasant relationships with his contemporaries. He was gifted with a very fluent and ready tongue, as may be inferred from the remark of Earl Spencer: 'A wonderful, wonderful man! He might become anything, even Prime Minister, if he would not talk so much.' His own comment was very characteristic of the man. 'A hundred men', he said, 'may be found fit to make Prime Ministers for one fit to judge the real merits of Shorthorns.'

[J. B.]

Bat Guano. See GUANOS.

Bath and West and Southern Counties Society.—In the year 1775 a Quaker, Edmund Rack by name, migrated from Wymondham, in Norfolk, and took up his residence in the city of Bath. Soon after his arrival in the city he contributed a series of articles in the local press on the agriculture of the district and the need of combined efforts for its improvement. He thought such efforts might be materially aided by means of a society, and expressed himself to this effect in the Farmers' Magazine. This led to the holding of a meeting at Bath on

September 8, 1777, resulting in the establishment of a society 'for the encouragement of Agriculture, Arts, Manufactures, and Commerce, within the Counties of Somerset, Wilts, Gloucester, and Dorset, and the City and County of Bristol'. Thus originated the association which has had a continuous existence ever since, and is now known as the Bath and West and Southern Counties Society; Rack, who has always been recognized as the author of its being, becoming its first secretary.

The newly-formed Society was not long in attracting attention and support, and among many others of note who worked and wrote on its behalf were Arthur Young, the agricultural writer; Dr. Priestly, the eminent chemist; Wm. Curtis, the botanist; the 'agricultural Duke' of Bedford, and Sir Benjamin Hobhouse. Premiums for the best farm stock and produce, together with medals and other awards for services rendered to science, art, and literature, were instituted; meetings for discussion were held; enquiries as to various modes of husbandry in different parts of the kingdom were set on foot; and reports and particulars of proceedings were annually issued. The Society continued on these lines for about fifty years, occupying, by virtue of its useful work, an influential position as a pioneer of agricultural progress But as it neared the 'forties its activity began to slacken and interest in it to diminish, and gradually it began to drop to the level of a purely local association. At this juncture the late Sir Thomas Acland, who had considerable influence in the West, formulated a scheme for endowing the Society with a fresh lease of life and a new constitution. By means of public meetings and in other ways, he successfully aroused the Western Counties in support of this, and the first show under the altered conditions was held at Taunton in 1852 Until then, the annual exhibitions were always held at Bath, but now the Society became migratory, and from that time has continued so. Immediate success attended this new departure, which has since been known in the Society as 'the great revival'. Until 1869 the locality of the show was confined to the Western Counties, but in that year its area was further extended by an amalgamation with the Southern Counties Agricultural Association, whereby an agricultural union was established between the west and south of England; to this Wales was afterwards added. The Annual Journal was enlarged and brought more up to date, under the editorship of the late Sir Thomas Acland, and became a medium for the ventilation of the views of leading agriculturists. The additional work undertaken in recent years has included the institution of a system of agricultural research by means of experimental stations; the establishment of schools for instruction in dairying; and practical and scientific investigations into such rural industries as cheese-making, cider-making, &c.; the Society being financially assisted in this by grants from the Board of Agriculture, county councils, and other public bodies. The Society has a staff of scientific experts, whose services are available to members.

The prizes for live stock and produce at the annual show usually amount to about £4000. There is also a very large exhibition of implements and machinery especially, whilst, in a fully-equipped working dairy, competitions are carried on and explanatory demonstrations of new processes are given by experts. Among other features of the show yard are exhibitions illustrative of nature-study, forestry, and horticulture, and competitions for the encouragement of various rural occupations and industries, such as shoeing, shearing, hurdle-making, &c. The Society has for some years past been financially prosperous, having an invested capital of over £20,000, in addition to plant and other property [T. F. P]

Bath Cheese.—In days long ago there was considerable demand for a full-milk soft cheese, erroneously said to be cream cheese. The consumption of this 'Bath cheese', as it was named, was brisk enough to command the services of a number of dairyers and dairymaids; but its popularity waned with the change in public fancy, and in 1908 it was made by one only, Mrs. Loxton, at the Creamery, in the city of Bath, and by her only occasionally.

From a remote but unrecorded period this erstwhile favourite product of the dairy was called cream cheese And indeed it was cream cheese, in the sense that it contained all the cream which was inherent to the milk from which it was made. For all that, however, it was not cream cheese in the sense in which the term is now employed, and it stood midway between cream cheese as it is understood to-day, and skim-milk cheese as it is understood any time. The real cream cheese of modern days, indeed, is made from cream only, which has been skimmed or separated from such fresh milk as that of which Bath cheese has all along been made, it contains a large proportion of butter-fat and a small one of casein.

The old-time Bath cheese, however, made either of full milk containing all its natural endowment of cream, or sometimes of cream taken from such milk, was a popular relish with the fashionable world in the gay city, and no doubt a healthy relish too.

Discontinued in the last decade of the 19th century, Bath cheese has been called back in the first of the 20th Whether the revival will expand, and become permanent, remains to be seen. But, in any case, it would seem desirable that a local type of cheese, that was once so popular, ought not to be allowed to die out. The modern representative of the ancient Bath cheese is circular in form, about 1 in. deep, and of varying diameters. The old Bath cheese was square in form, 9 in. × 9 in. and 1 in. deep.

The way the modern article is made is as follows:—Three gallons of milk are renneted at a temperature of 90° F. It will coagulate without loss of time, and should stand an hour in a room whose temperature is about 57° F., by which time the curd is ready to be ladled out of the vessel in which it has been coagulated, into the circular or rectangular moulds, in which the embryo cheeses remain until ready for turning over on straw mats. The cheeses will be about three days draining away the surplus moisture, and about three or four to eight or nine days ripening, according to the time of the year, and to the measure of ripeness desired.

The modern Bath cheese, like that of old, is, in all senses and meanings, essentially a soft cheese rather than a cream cheese. This will be patent when it is stated that 3 gal. of milk will yield sufficient curd to make four circular cheeses, each of which sells at fourteen to sixteen pence, according to size, yielding a comforting profit to the maker and a gratifying food to the consumer.

During the earlier stages of the ripening process the cheeses remain in circular moulds or boxes, which may with advantage be perforated around the side to facilitate the escape of the whey, which, however, should not escape too quickly. In the later stages the cheeses do not need the moulds, inasmuch as they are firm enough to rest on the straw mats, without any perpendicular support beyond that which their own consistency affords

The cheese is ripe when it cuts close-grained and has a creamy texture, accompanied by an acid flavour which is distinctly tasted though not very pronounced. Its ripeness should synchronize with mellowness. The two, indeed, are synonymous, and the cheese will demonstrate the condition by spreading on bread, as butter does, with the aid of a knife. [J. P. S.]

Bats (Cheiroptera), an order of mammals in which the power of flight is almost as highly developed as in birds, though the details of the mechanism are very different. A fold of skin, which usually begins from the shoulder, extends along the upper margin of the arm to the base of the thumb, thence between the elongated metacarpals and fingers, and along the sides of the body to the ankle, and even to the tail. It is interesting to contrast the bones of a bat's wing with those of a bird's; thus, in the bat, the ulna, which is far stronger than the radius in a bird, is weak and incomplete; there is some fusion of the wrist bones, but nothing like the reduction (to two free carpals) which is seen in birds; there are five digits instead of the bird's three; and the metacarpals and the phalanges of the four fingers are greatly elongated. At the same time, there is no finer example of fundamental similarity in spite of difference in detail; in technical phraseology the bat's wing is *homologous* with the bird's, both being modified fore limbs; and it is also *analogous*, both being organs of true flight, *i.e.* used for beating the air.

The bat's thumb is always short and clawed, and stands out from the membrane of the wing; in the fruit-eating bats of warm countries the second finger is also clawed. In adaptation to the flight, the pectoral girdle is strong, there is a well-developed clavicle, and the coracoid process is always long and curved. It is interesting to find that the breast bone bears a slight keel, suggesting the strong keel of flying birds, and adapted like the latter for the better insertion of some of the muscles used in flight. The hind limb is relatively short when compared with the fore limb; the knee is turned backwards; the fibula is very weak except in one sub-family, and is remarkable in being incomplete proximally; one of the ankle bones bears a bony spur which supports the beginning of the free margin of the fold of skin between the ankle and the tail, the five toes are clawed. The skull, like the rest of the skeleton, has many interesting features, but we can only call attention to the sharp cusps on the back teeth in the insectivorous types. As regards soft parts, it must suffice to call attention to the poorly developed brain, and the usually simple stomach. There seems to be no doubt that the bats have evolved from primitive Insectivora.

Bats have a high body temperature. The sense of touch is highly developed in the skin of the wing, the large external ears, the whisker hairs of the snout, and the curious plaited 'nose leaves' of some genera. Even when deprived of sight, hearing, and smell, bats will fly about a room without touching numerous wires stretched across it.

The Pipistrelle or Dwarf Bat (*Vesperugo pipistrellus*)

Bats are slow-breeding animals. In Britain only a single young one is usually produced at birth, although on the Continent, it is said, the same species occasionally produce two. Pairing takes place in autumn, but the sperms are only stored in the uterus, for ovulation and fertilization do not take place till spring. The young bat is born, blind and naked, late in June or early in July, and it is carried about clinging to the fur of the mother till it is able to fend for itself. There are two thoracic mammæ, generally post-axillary in position.

All the British bats belong to the Insectivorous group, the fruit-eating bats and the blood-sucking forms being confined to warmer regions. There are fifteen species on the British list, but of these three are very rare Among the most noteworthy forms are the Greater and the Lesser Horseshoe Bats, which belong to the 'leaf-nosed' group, and the Long-eared Bat, in which the ears are nearly as long as the whole head and body. These enormous ears are laid back against the body when the bat is at rest, and the earlet or tragus projects forward and looks like a true ear. The Noctule or Great Bat occurs in the south of England, and the various members of the closely allied genera Vespertilio and Vesperugo are more or less general. The commonest British form is the little pipistrelle or 'flittermouse' (*Vesperugo pipistrellus*), which may be seen anywhere throughout the British Isles any time between April and November. Like all other bats it is nocturnal in habit, and if found abroad before twilight is dazed and stupid It flies at a height of 10 to 20 ft., with an uncertain fluttering movement, 'not rapid like that of a bird, but rather like that of a large moth or butterfly'. It feeds entirely on insects, especially on the flies, gnats, and moths which it catches upon the wing. The days are passed hidden in crevices or under the roofs of old buildings, or even in hollow trees It sleeps in similar places throughout the winter, hanging head downwards by the claws of the hind toes, but hibernation is not so complete as in many other species, for it is easily disturbed, and may sometimes even be seen flying about on mild winter evenings. During hibernation the respiration of bats comes almost to a standstill, and the heart beats very feebly, only some twenty-eight times a minute. [J A T]

Batts.—A common name in some districts for Colic. See Colic

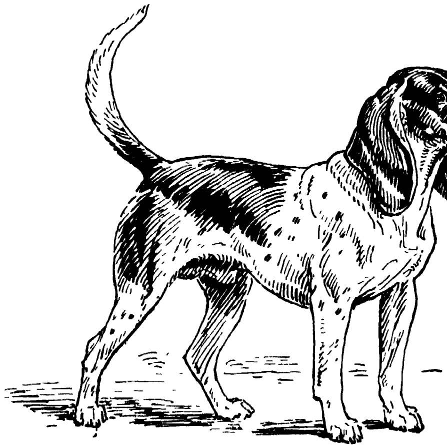
Bay Colour. See Colour in Animals.

Bay Tree. See Laurus nobilis

Beach, Raised. See Raised Beach.

Beagle, The.—Speaking generally, the Beagle may be referred to as a miniature foxhound, the chief distinctions between the two varieties being that the Beagle is by comparison rather more delicate in the formation of its head and finer in muzzle, whilst many of the best specimens possess more loose skin about the neck, and are in consequence more throaty than the foxhound. The antiquity of the Beagle is undoubted, and there are reasonable grounds for believing that there is a justification for the belief entertained by some fox-terrier breeders that the little hounds are entitled to a considerable share of the credit of having assisted in establishing the fox-terrier over a century ago. This question, however, is more closely associated with the latter breed than the Beagle, and may therefore be deferred until the fox-terrier is under consideration.

Of late years a considerable amount of attention has been devoted to the Beagle by several influential breeders of dogs, a result of this being that far more care has been expended upon the selection of crosses, and a corresponding improvement has been effected, not merely in the appearance but in the working powers of the breed. As a matter of course, the greatest value of a hound rests in its scenting power, as unless this faculty is thoroughly developed the animal is simply worthless for hunting purposes, and therefore all interested in beagles, provided that they are practical sportsmen, attach primary importance to the scenting power of their little hounds. This faculty naturally must be inherent to a breed if it is ever to assume a recognized position amongst hunting varieties, and hence the absolute necessity of only breeding from parents which have proved their possession of a nose. No doubt the hunting spirit and the ability to follow out a line is capable of being developed in any hound, but whilst admitting this, it must be added that the faculty is invariably more strongly developed at the outset in animals which are the direct descendants of a line of ancestors which have been hunted, than in one which comes of parents bred from a race of toy dogs, and unentered beagles are simply nothing more nor less than the latter.



Beagle

The hunting powers of the Beagle are undoubtedly great, provided, of course, that they have been properly developed; but as of late years there has been a tendency on the part of breeders rather to reduce the height of their little hounds, there are some miniature packs which are quite unable to hunt the hare. These pocket beagles, as they are called, are, however, capable of providing first-rate sport if used for drag-hunting, and as their small size naturally renders them slower than the taller hounds, more people are equal to the exertion of following them on foot than if they stood more inches at the shoulder.

It is perhaps owing to the fact that the constitutions of the pocket beagles have been weakened in some cases by the effects of in-breeding, and in others by raising puppies from weakly parents in order to effect a reduction in size, but it is unfortunately impossible to deny that they are not easy to rear. When, however, their youthful delicacy and their liability to suffer severely from distemper have been overcome, the little hounds as a rule cause no trouble to those who have them in charge; but it unfortunately happens that it is usually the best and smallest ones which fall victims to the ills which beset puppyhood.

As observed above, the general appearance of the Beagle closely resembles that of its more amply developed relative the foxhound, with the exception that it is more throaty, the skull and muzzle are proportionately finer, and the ears of the Beagle are set on lower than in the case of the larger hound. The head should show plenty of length, and the skull must be somewhat domed at the top, any approach to absolute flatness being regarded as a great fault. The muzzle is inclined to be fine at the nose, but it is apt to present an appearance of being less massive than it really is, for on looking over a Beagle one is irresistibly reminded of the foxhound, and involuntarily the truncated muzzle of the latter is sought for. The nostrils should be well developed, as is desired in the case of all animals which are expected to develop scenting powers, and the eyes are rather full, with a very soft expression, and of a dark hazel or brown colour. The neck should be rather long and set on to shoulders which are both lengthy and set well back, for the Beagle, whatever his size is, should be a galloper, and the chest must be deep and the ribs nicely sprung, so as to provide ample space for the heart and lungs to work in. A great point is the proper development of the fore legs, which should be perfectly straight and heavy in bone; they should show no weakness about the pasterns, and the feet must be well developed, round, and compact. The body should be powerful, with a flat back, strong loins, whilst the stern should be coarse and carried gaily, as in the case of the foxhound. The hind quarters must be powerful, and the legs so formed as to be capable of carrying their owners properly, any tendency towards being cow-hocked, *i.e.* in at hocks with out-turned stifles and feet, being a very serious fault. Any hound colour is permissible in the Beagle, but black, tan, and white, and lemon and white, are the most favoured, whilst the height extends from under 12 to 16 in. at the shoulder. [V. S.]

Beale, Dr. John (1603-1683), was an ardent promoter of horticulture and agriculture. He was a native of Herefordshire, and did much to improve and extend the orchards of this county. His chief publication was 'The Hereford Orchards, a Pattern for the Whole of England'. [J. B.]

Beam Tree, another name for the Service tree. See SERVICE TREE.

Bean Goose. See WILD GOOSE.

Bean Meal.—Bean meal is, properly speaking, that which is obtained by grinding the whole seed of the Horse Bean (*Faba vulgaris*). The crushed bean ought not to be subjected to any process of sieving for removal of the husk; it not infrequently happens, however, that the husk is partially removed, and this used again for inclusion in other meal, so that the proportion of husk in bean meal that is purchased may be of very variable amount. This is shown in the analysis by the varying proportion of woody fibre contained. In the whole bean the husk comprises about 15 per cent by weight of the mature seed.

Chemical analysis shows bean meal to be a food very rich in both nitrogenous and starchy matters, the nitrogen being present almost entirely in the albuminoid form known as 'legumin', a body analogous to the casein of milk. Of this body there is from 20 to 25 per cent in the whole bean. The quantity of starch in the whole seed is about 35 per cent, while there are 10 per cent or so of other carbohydrates and a little over 1 per cent of fat. The mineral matters or ash constituents, which amount to rather over 3 per cent, are of considerable importance, being particularly rich in phosphoric acid and potash. Silica, on the other hand, is very low in amount. The following may be taken as the analysis of an average good sample of bean meal.—

Water	14·3
Fat	1·5
Albuminoids	22·6
Amides	2·8
Soluble carbohydrates, &c.	48·5
Woody fibre	7·1
Ash	3·2
	100·0
Nitrogen	4·07

The composition of the mineral matter or ash is, according to Wolff, as follows:—

1000 parts of dry substance yield 36·26 parts of ash, consisting of—

Potash	15·06
Soda	·39
Lime	1·81
Magnesia	2·60
Oxide of iron	·17
Phosphoric acid	14·11
Sulphuric acid	1·23
Silica	·24
Chlorine	·65
	36·26

The proportion of nitrogenous to non-nitrogenous matter is 1 : 2·3. Of the nitrogenous constituents 89 per cent are digestible, and of the carbohydrate matter 93 per cent.

Bean seed is much richer in nitrogen than any of the cereal grains grown on the farm. This fact, together with the nature of its mineral constituents, makes bean meal a very valuable material for feeding purposes, and it is essentially a muscle-forming food. It is known as a 'strong' food, and recognized as one of somewhat 'heating' character. Accordingly, it is a more suitable material for stock of mature age, and such as are able to digest nitrogenous food, than for young stock, or for animals such as pigs, which thrive best on a starchy diet. Split beans are well suited for horses in hard work, a common diet for these being a mixture of split beans with oats in the proportion of 1 part of beans to 3 parts of oats. Beans are also used, when boiled, as a 'mash' for horses out of condition. For general feeding, however, beans should not be soaked or boiled, but given dry.

For dairy cows bean meal is a favourite food, being given up to the rate of 5 to 6 lb. per head daily for cows in full milk. So far as any feeding material is able to influence the quality of milk, and produce an increase in the fat contents, resulting in a richer milk, bean meal is most likely to effect this. It tends to give a butter of hard texture.

For mature sheep, and especially for rams, bean meal is also a good food, ½ lb per head daily being an average quantity given.

In a mixed diet bean meal may be quite well used to replace decorticated cotton cake.

Its manurial value is high, mainly because of its richness in nitrogen, phosphoric acid, and potash. According to Lawes and Gilbert's tables, as revised (1903) by Voelcker and Hall, the compensation for the unexhausted manurial value of each ton of bean meal consumed is

For the last Year	2nd Year	3rd Year.	4th Year
31*s* 8*d*	15*s* 10*d*	7*s* 11*d*	3*s* 11*d*

In place of the home-grown bean (*Faba vulgaris*), beans are imported from Egypt, India, and elsewhere. These come, as a rule, mixed with a good deal of earth and dirt, which frequently have to be removed by washing. Though many of these are varieties of the common Horse Bean, and are quite good foods, others are of quite different nature, and not a few are possessed of distinctly poisonous properties. Such are the beans known as 'Java Beans', 'Rangoon Beans', &c., varieties of *Phaseolus lunatus*, and they have been found (Dunstan and Henry) to contain a cyanogenetic glucoside (lunatin) which, under the influence of an enzyme present in the seed, produces hydrocyanic acid when the seed is macerated with water. The detection of these seeds when ground and mixed with ordinary bean meal is a matter of considerable difficulty, and, because of its dangerous nature, foreign bean meal is to be regarded with suspicion.

Indeed, the best advice to the farmer is to avoid the purchase of bean meal altogether, and either to crush his own produce, or, if he purchases, to get beans in the whole state and grind them himself. In this way he will avoid the presence of harmful ingredients, and also of an undue amount of husk. [J. A. V.]

Beans.—This name is given to a number of plants. By Linnæus the Common Bean was included among the vetches in the genus Vicia under the name *Vicia Faba*, L. It differs, however, from most of the vetches in having a non-climbing stem capable of standing erect without a support, a peculiar fleshy pod, and leaves which have no tendrils. On account of these peculiarities the bean is sometimes placed alone in a separate genus, Faba, being then spoken of as *Faba vulgaris*, Mœnch. The seed, which is used extensively as food for man as well as farm animals, has a tough, leathery testa or skin, within which is the embryo with its two thick fleshy cotyledons. There is a well-defined elongated hilum or 'eye' at the point where the seed was attached to the inside of the pod; it is usually black, but in certain varieties is white or coloured. After germination the strong tap-root grows vertically down into the soil and the stem comes above, leaving the cotyledons within the seed-coat in the ground. In ordinary soil the main root and secondary laterals soon become studded with somewhat large pinkish tubercles containing the bacteria which assist in the assimilation of free nitrogen from the air.

The stem of the bean is four-sided, angular and hollow, without branches, and varies in height from 2 to 4 or 5 ft. according to the variety. Generally three stems spring from each seed—the main axis and two lateral axes which arise in the axils of the cotyledons. Sometimes more than these are present, but not infrequently some of the stems are damaged or suppressed. The leaves are abruptly pinnate, with one to three pairs of elliptical leaflets, and a small terminal point in place of a tendril. The flowers are arranged in two to six flowered racemes in the axils of the leaves all along the stem. They are of the usual papilionaceous type, with white 'standard' and 'keel', the 'wing' petals are white with a velvety black on each. In some varieties all the petals are white, others are tinged with red. The pods when young are fleshy and green, with a soft, spongy lining; later, they become harder and black.

The bean is one of the most ancient of cultivated plants, and was grown in Europe in prehistoric times. It has not been met with in a wild state, but probably originated from a wild species formerly indigenous in the Caspian district and in North Africa.

A large number of varieties of *Vicia Faba* are known; they are usually divided into the following two groups:—

(*a*) FIELD VARIETIES (*V. Faba arvensis*).

(*b*) GARDEN VARIETIES (*V. Faba hortensis*).

(*a*) The chief varieties in cultivation on the farm at the present day are.—

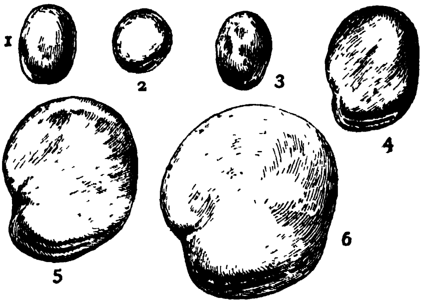
1. *The English Horse Bean: Tick Bean.*—Several varieties of Tick or English Field Bean are on the market, but the differences between them are too indefinite and inconstant for accurate description. They are all prolific kinds, and produce short, plump, cylindrical seeds with rounded ends. The average weight of 1000 seeds is about 18 oz. The tick bean grows

from 3 to 4 ft. high, and is chiefly grown in the warmer southern parts of Great Britain on medium loam.

2. *The Scotch Horse Bean.*—This is a somewhat stronger and taller variety than the English form, more hardy, with seeds which are similar to the latter in shape and colour, but larger and having slightly flattened sides. The average weight of 1000 seeds is about 27 oz.

3. The *Heligoland Bean* is a variety growing about 3½ ft. high, with small roundish seeds, smaller than either of the two previously mentioned kinds, and of chocolate colour. It is prolific and early, and adapted for growth on rich land in late districts. A thousand seeds weigh about 12 oz.

4. *Winter Field Bean*—This variety is capable of standing through ordinary winters if sown in October. It grows about 3 or 4 ft. high, and has small roundish seeds, 1000 of which generally weigh from 12 to 13 oz In typical seeds the hilum is jet black, and near it is an olive greenish spot.



Beans

1, English Horse Bean (Tick Bean) 2, Heligoland Bean, 3, Winter Bean, 4, Mazagan Bean, 5, Long-pod Bean, 6, Broad Windsor Bean.

(*b*) The garden varieties of bean have flat, fleshy pods containing from three to five large flattened seeds. They are all rather delicate plants, and need a warm climate to ripen properly, many of the commercial samples of seed for garden use being grown in Spain and other warm parts of Europe. The seeds of most of them are cooked as a vegetable before they are mature.

1. The *Early Mazagan Bean* belongs to this division, but is occasionally grown in arable fields. It has a slender stem 4 to 5 ft high, and bears pods on which are four or five flat, pale, whitish seeds; 100 seeds weigh about 3 oz.

2. Several varieties of *Long-pod Beans* are met with. They are garden sorts which are sometimes grown in fields. The stems are from 4 to 5 ft. high, rather stiff, and bear broad pendulous pods often 6 or 7 in. long. The seeds are nearly an inch long and ⅝ in. broad; 100 of them weigh about 5½ oz. Red-flowered and white-flowered varieties are known.

3. The *Broad Windsor*, or White Windsor Bean, is perhaps the most extensively cultivated garden variety. The plants are usually about 4 ft. high, and bear short broad pods containing two or three whitish flat seeds, about an inch in length and nearly the same in diameter. A green-seeded variety is also met with, which, like the ordinary White Windsor, ripens irregularly, so that useful produce may be gathered from the crop day by day for some time. The average weight of 100 seeds is between 10 and 11 oz. See also art. BEANS, GARDEN. [J. P.]

There are many associations of great antiquity connected with beans They were believed by some of the ancients to contain the souls of their ancestors. It has been said that Pythagoras would not eat beans for this reason, and one of the bean family still retains the name of the Pythagorean bean. A black bean was the original form of blackballing an obnoxious candidate; and Lucian has a passage to the effect that to eat beans is equivalent to eating your father's head! Beans are said to have been introduced into this country through the Moors, who brought them to Spain, and from whence they passed to France, and later to England. But it is not improbable that they were first brought to Britain by her Roman conquerors. They constitute a prominent member of 'pulse' crops, and, as Leguminosæ, are related botanically to peas, lentils, lupins, vetches, clover, and other crops belonging to this large order. The importance of beans as a British farm crop has declined of late years from an area of 584,251 ac., produced over the United Kingdom in 1869, to 256,383 ac. in 1905, but there was an increase to 311,684 ac. in 1907. The principal bean-growing counties are:—Suffolk, Lincoln, Essex, Cambridge, Norfolk, Northampton, Bedford, York, E.R, Huntingdon, Gloucester, Kent, Warwick, Oxford. Over several counties beans are almost unknown as a farm crop, the total area being generally under 100 acres in Cornwall, Cumberland, Derby, and Westmorland, and under 1000 in thirteen other counties. With the exceptions of Gloucester and Warwick (both clay-land counties), the principal bean-growing area is in the eastern counties of England, Lincoln, Suffolk, and Essex holding the front rank, each having considerably over 30,000 ac. under this crop. Scotland only contributes about 12,000 ac., and Wales little over 1600 ac. See BEANS, STATISTICS OF.

Beans are largely imported from Egypt, Turkey, Greece, and the Netherlands, and foreign can be purchased for less money than home-grown beans. Another cause of the decline in bean cultivation is the large extent of bean land which has been laid down in permanent pasture since the great fall in the values of wheat. A third cause is the uncertainty of the crop owing to the attacks of the Black Dolphin or Bean Aphis, and other causes.

Beans are a clay-land crop, and are represented in all rotations suitable for such soils. In Essex they are taken as follows.—

Fallow, oats, clover, wheat, beans, wheat.

The old three-field course included successively—

Bare fallow, wheat, and beans.

The Holderness rotation is given as—

Fallow, wheat, beans, wheat, clover, wheat.

A Scotch course is—

Fallow, wheat, beans, wheat.

Another Scotch rotation of six years' duration consists of

Potatoes, wheat, beans, barley, clover, oats

In East Lothian a recognized system of cropping is—

Fallow or roots, wheat or barley, seeds, oats, beans or potatoes, wheat

Another Scotch practice is to grow the beans in mixture with oats, a crop locally known as 'mashlum'.

In Buckinghamshire, beans and wheat have often been taken alternately for many years in succession upon what is termed 'wheat and bean land'.

CULTIVATION OF BEANS. Although beans are generally sown in the spring, the Winter Bean is a notable exception. As its name implies, this variety stands the winter, and is usually sown in October. It is grown upon lighter soils than the Spring Bean, and is earlier ready for harvesting. The Winter Bean is a favourite in Scotland and in England, and is a fine and rather small variety.

Spring beans include only a few varieties, among which may be mentioned the English Tick Bean, a fine and round variety; the common Horse Bean, of larger size and flatter shape; the Heligoland Bean, small and dark-coloured; and the Mazagan, also a fine and small variety. Of these the Tick is the most generally grown, and may be taken as the type of spring beans. Although beans are not as widely grown as many other crops, few can compare with them in variety of modes of cultivation. They are drilled, dibbled, broadcasted, ploughed in, hoed in, and dropped in by a bean barrow. They are sown on the flat, and are drilled on raised ridges, like turnips. They are hand-hoed, horse-hoed, and earthed up; and the cultivation followed is often elaborate. Take, for example, the cultivation as practised in Midlothian, where beans are taken after an oat crop. The oat stubble is ploughed with a strong deep furrow in autumn or early winter, and is allowed to lie till a suitable time in February or March. The land is then harrowed or dressed to break the furrows, and raised with a double mouldboard plough into ridges 27 in. wide. The manure is spread on the raised drills, and the seed is deposited with a machine taking three drills at a time, at the rate of 3½ to 4½ bus. per acre. The drills are then split over the manure and seed, precisely in the same manner as is practised for turnips. The drills are harrowed lengthways and rolled shortly before the beans appear. After the plants are well up, a plough with the mouldboards removed is passed through the drills. The plants are then hand-hoed, horse-hoed, and again hand-hoed, before they close in. Pricing out all these operations, including seed but excluding the value of the manure, the cost of the cultivation amounts to £4 per acre.

On the Fen lands, where beans are taken after corn, the land is raftered, harrowed down, and 'couched'; ploughed 5 or 6 in. deep; ploughed a second time in November and left till seed-time. Ridges are then raised 27 in. wide, and the manure is spread in the bottoms of the ridges. The seed is drilled on the dung, and the ridges are then split over both manure and seed. The ridges are harrowed down before the plants appear, and when the beans are 2 to 3 in. high they are horse-hoed. Hand-hoeing is employed when necessary, and in any case the horse-hoeing is repeated. Some growers 'earth up' the land over the stems.

In Essex, which is a principal bean-growing county, the crop is grown after wheat. The beans are dibbled, two in each hole, on a newly-turned furrow. Three men dibble to each plough, and deposit the seed in every second or third furrow. When the plants appear they are harrowed and afterwards hoed.

Beans possess strong and deep-searching roots, and they flourish in moist, heavy clays. The stalks reach a height of from 3 to 5 ft according to the variety sown, their foliage is broad and vigorous, and the crop, if successful, completely covers the land and smothers weeds.

Although broadcasting is mentioned above as a method of sowing, it is not to be recommended. When drilled and well hoed, beans are a cleaning crop, but if broadcasted they are liable to encourage weeds. Wide drilling and frequent hoeing produce excellent results on good land. Narrow drilling does not permit of horse-hoeing, but at the same time allows the plants to shut up the interspaces between the rows earlier.

The Scotch practice of growing beans in mixture with oats is followed on stiff clay soils. The 'mashlum' is taken after pasture, and the land is ploughed in the ordinary way as for a cereal crop, and receives no further treatment. In the month of February beans are broadcasted at the rate of 2 to 3 bus. per acre, and are roughly harrowed, and just when the beans are becoming ready to force their sprouts through the surface soil oats are also sown broadcast at the rate of 2 to 3 bus. per acre, and the harrowing of the surface is then completed. A difficulty in this method of cultivation is to delay the ripening of the oats till the beans are also mature, and this is met by using a late variety of oat and by sowing the beans earlier. The harrowing in of the oats subsequently assists the brairding of the beans by enabling them then to break more easily through the tough crust that is liable to be formed on the surface of clay soils. The practice of growing mashlam is considered a very good one. The growth of broadcast beans alone is apt to leave very foul ground, but the mixture of oats chokes out the weeds. A good crop is also ensured, the beans or the oats predominating according as the season favours either the one or the other plant. The mixture of bean and oat straw makes a more nutritive fodder than oats alone, and a more generally useful fodder than bean straw alone, while the grains are easily separated from each other in the granary by winnowing or riddling, and may be used together either for horse or sheep feeding, or ground into meal for cows and pigs.

The manuring of the bean crop was made the subject of experiment by the late Dr. A. P. Aitken. His conclusions were that the most important constituents of a bean manure are potash and lime, and in a less degree phosphoric acid. Nitrogen, though less necessary, was found to be of some value when applied as nitrate of soda. The most general practice is to grow the bean crop on farmyard manure, which supplies all the necessary potash and phosphoric acid. As it also supplies a very large quantity of nitrogen which the bean crop does not require, the practice of applying farmyard manure to the bean crop, unless in very small dressings, cannot be regarded as an economical one In the Highland Society's experiments, and subsequently in those of the West of Scotland Agricultural College, it was found that the bean crop could be quite successfully grown with artificial manures alone. In the latter series the most profitable results were obtained from a dressing of 6 cwt superphosphate and 2 cwt. sulphate of potash (96 per cent purity) per acre, applied with seed that had been inoculated with nitroculture In the absence of the nitroculture an application of 1 cwt. nitrate of soda per acre was found beneficial but not very profitable.

Winter beans pod or 'kid' near the ground, while spring beans flower continuously up the stems. This exposes the latter to the attack of the bean fly, and renders it necessary in some cases to cut off the tops and carry them off the field. Winter beans are among the earliest crops ready for harvesting, while spring beans are the latest. Winter beans, being short, are often tied up with straw bands When ricked they are best thatched on the sides as well as on the top, on account of the large number of pods on the stubble ends. They must also be cut close to the ground. Beans are ready for cutting as soon as the softer part of the leaf falls, leaving the midribs attached to the stalk They resist wet weather in harvest better than any other crop, and are often left out long after other grain crops have been secured. So often is this the case, that in announcing that his harvest is finished a farmer will add, 'except a few beans'.

The yield per acre is comparatively uncertain, owing to disappointing podding and insect attacks. Five quarters is a good crop, but this yield may easily be reduced to 4, or even 3, quarters per acre. Good beans weigh 70 lb. per bushel, and are then a most valuable crop to the stockkeeper. Old beans are highly esteemed by sheep-breeders for ram lambs, and by horse-feeders for horses when on hard work.

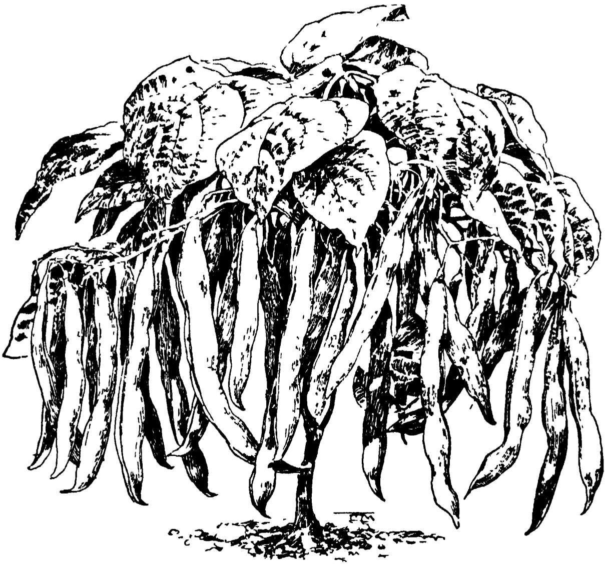
The nitrogen content of beans is very high, and causes them to rank with linseed and cotton cakes in all cases of compensation for foods consumed. In common with other leguminous crops, beans possess the power of fixing the free nitrogen of the air by a process of symbiosis, and the cultivation of the crop is therefore valuable as a means of increasing soil nitrogen. (See NITROGEN FIXATION.) The leaves and the straw of beans are both highly nitrogenous, and the fall of the leaf is of considerable manurial value. If well harvested, bean straw may be cut into chaff and steamed, and makes an excellent food for cows, and it is also used dry for racking up horses at night. See art. BEAN STRAW.

Like clover, beans are a good preparation for wheat, as both these crops leave the soil rich in nitrogen The system of growing wheat and beans alternately should not be passed over without remark, especially in connection with continuous corn-growing. Certainly to take beans and wheat in succession is preferable to taking wheat after wheat. The tillage of beans is conducive to cleanliness, and at the same time enriches the land for the wheat crop. Wheat is also a good preparation for beans, as it allows of plenty of time for winter cultivation between harvest and sowing

With so many advantages it appears surprising that the area under beans should have become so much reduced It is a question of importance whether a good crop of beans might not prove as valuable to stockkeepers as a crop of roots containing 90 per cent of water. A bean field in flower is a beautiful sight, and the odour of such a field may become one of the sweetest reminiscences of the country. The chief insect enemies of this crop are: the Bean Aphis, Collier, or Dolphin (see APHIDES), bean weevils (see SITONES), and the bean beetles (see BRUCHUS) See also next article. [J. Wr]
[R. P. W.]

Beans, Garden.—There are three distinct kinds of bean which rank among the most important English garden vegetables, namely, the Broad Bean (*Vicia Faba*), the French or Kidney Bean (*Phaseolus vulgaris*), and the Scarlet Runner (*Phaseolus multiflorus*). The BROAD BEAN is supposed to have come to us from Egypt; at any rate it was cultivated by the ancient Egyptians, and it appears to have been a popular food in Europe for centuries. For its cultivation a deep, well-manured soil gives the best results, the quality of the beans depending upon the generous treatment the plant receives, a fact which is overlooked owing to the readiness with which broad beans grow and pod even on the poorest soils. The seeds are sown singly 6 in. apart, in rows a foot apart, a depth of 3 in. being safest. When the plants have grown a few inches they should be earthed up, and when pods have begun to form on the lower part of the stem the top should be pinched out. The first sowing may be made in a sheltered border in November, but for ordinary purposes a sowing in March will be quite early enough. There are numerous varieties, the most popular being Windsor and Long Pod. The pods are fit to gather as soon as the beans are about full grown. If left longer, the skin of the bean becomes tough, and the flavour is strong. A black fly (*Aphis Fabæ*) attacks the stems, and if not kept in check by the application of an insecticide, it increases at an astonishing rate and spoils the whole crop.

The Kidney Bean is a native of South America, but it is now cultivated all over the world, and is highly appreciated as a delectable and nutritious vegetable. It is easily grown, a prolific cropper, and may be had all through the summer with a little management. A warm sunny situation suits it best, and it is quite deserving of the front of a south wall for an early supply. Soil that has been manured for a previous crop, such as potatoes, is quite rich enough for kidney beans, but if manure is to be added, half-rotted stable dung dug in at the depth of about a foot is best. For the main crop, sowings should be made early in May, and for the dwarf varieties a sowing every three weeks to the end of July will be necessary to keep up a regular supply till the end of October. In dry weather, water must be given freely, and to do this thoroughly the soil on each side of the rows should be drawn up, so as to form a shallow trench about the beans. The dwarf varieties should be sown in rows 2 ft apart, making a broad furrow with a draw hoe, scattering the seeds 2 or 3 in. apart, and then covering them to a depth of 3 in. Climbing varieties, commonly known as Kidney Beans, the term French Bean being applied to the dwarf kinds, should be staked like peas.


Kidney Bean (*Sutton's Perfection*)

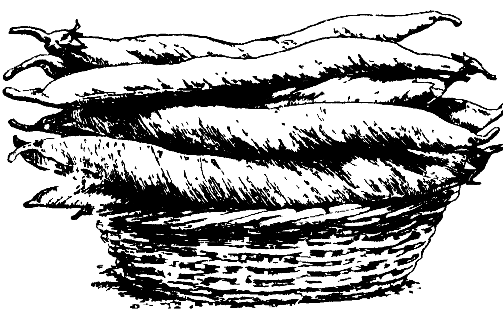
The pods are at their best when they are three parts grown. They should never be left longer than when they are so crisp as to readily break clean and show no fibre. It is advisable when gathering to remove all the large pods, even though they may not be required by the cook, as this ensures a succession of young pods, whereas if some are allowed to remain till the seeds approach maturity, scarcely any young ones will develop. There are two well-marked sections, namely, the tough-podded, the pods of which become leathery or stringy, and what are known as the edible-podded, which never become stringy, and may therefore be used until they are quite old. If there is a superabundant supply of kidney beans, they may be preserved by placing them in jars with salt, and keeping them in a dry cool place. The ripe beans are what are known as haricot beans, which can be used in a variety of ways, and are most nutritious.

The following is a selection of sorts:—Dwarf Beans—*Canadian Wonder*, a deservedly popular variety, a strong grower, heavy cropper, with long, narrow, tender, agreeably flavoured pods. *Dwarf Butter*, a free grower, bushy, 2 ft. high and a great bearer; pods 4 in. long, thick, fleshy, yellow green, cooking tender, and of excellent quality. *Early Favourite*, an immense cropper, the pods up to 9 in. long, of excellent quality. *Early Wonder*, dwarf and compact in habit, very free, tender, and excellent in flavour. *Ne Plus Ultra*, about a foot high, early, productive, very tender, a good one for preserving; pods of medium length. *Sion House*, about a foot high, with long, tender-fleshed pods, generally tinged with purple. *Sutton's Perfection*, an excellent variety, forming a broad dwarf cluster of stems which crop very freely, the pods being larger than in most varieties.

Climbing or Kidney Beans – *Giant White*, the largest podded, a very free and continuous cropper, the pods over a foot in length, proportionately broad, thick, and fleshy. *Earliest of All*, remarkable for the earliness with which it forms pods. They are at their best when about half grown. *Excelsior*, a robust grower, 10 feet or more high, the pods produced in large clusters, an excellent vegetable, and a favourite with exhibitors. *Sabre*, very popular with French market-growers, and in warm summers a free cropper in England, the pods being a foot or more long, and an inch wide. *White Longpod*, grows 6 or 7 ft. high, is excellent when dry, keeping in this condition for months.

Scarlet Runner (*Phaseolus multiflorus*).—Whilst the other beans are annuals, this is a perennial, forming a fleshy rootstock like the Dahlia, and therefore may be preserved through the winter in a dry place, to be planted out in April. The usual practice, however, is to raise it annually from seeds, as this gives less trouble, and the seedlings bear just as well as older plants. A deep, rich soil suits them best, and the seeds should be sown at the beginning of June. If a frame is available, the seeds may be sown singly in 3-in. pots in April, and the plants thus raised planted in the open border early in June, about a foot apart, in rows 3 or 4 ft. apart. The stems climb to a great height, as much as 20 ft. They therefore require very tall stakes, but as these are not always easy to get, stakes 7 or 8 ft. may be used, and if the rows are planted 6 ft. apart, stakes may be stretched across from one row to the other, so as to form a kind of pergola on which the stems may be trained, and the gathering of the beans then presents little difficulty. Stout string may be used instead of the cross sticks. To save space, it is usual to plant early potatoes, spinach, or lettuce between the rows of scarlet runners, as they will be ready for gathering before the beans will have completed their growth. Scarlet runners will live under indifferent treatment, but no vegetable gives a better return for liberal cultivation than they do. A mulch in the summer with good manure, liberal watering should there be a shortage of rain, and the training of the shoots as they grow, should therefore be found time for, if the best results are aimed at. The best varieties are.—*Painted Lady*, with scarlet and white flowers; *Scarlet Runner*, with red flowers; *Sutton's A 1*, which has enormous pods, deep-green, and of excellent quality, and *White Runner*, with white flowers and white beans.

[W. W.]



Scarlet Runner (*Sutton's A 1*)

Beans.—Parasitic Fungi.—

RUST.—A common pest on garden and field beans and peas, also on several wild species of vetches and other Leguminosæ. The rusted leaves fall off prematurely, and considerable loss may result from diminished production of pods. The fungus concerned (*Uromyces Fabæ*), a member of the Rust fungi (Uredineæ), bears all its forms of spores on the same host plant. The cluster-cup spores (æcidiospores) appear first in spring on pale and swollen patches. Later, uredospores and teleutospores are given off as a yellowish-brown powder. The teleutospores remain dormant till the following spring, when the secondary spores (conidia) given off by them infect young plants.

POWDERY MILDEW.—All leguminous plants are liable to attacks of this white mildew (*Erysiphe*), especially in dry seasons. See PEA MILDEW.

DOWNY MILDEW.—In warm, moist seasons, beans and other leguminous plants may be damaged by a white mildew (*Peronospora viciæ*), which differs from the powdery mildew in that the foliage and pods quickly become discoloured and rotten.

POD-BLOTCH.—Pale or brownish blotches on badly developed pods are generally caused by a fungus (*Ascochyta pisi*). See PEA LEAF-BLOTCH.

Treatment.—These fungi are kept in check by spraying at intervals of about ten days with Bordeaux mixture or cupram (see FUNGICIDES). This operation will always be possible in the garden, but cannot well be employed amongst tall plants in the field. As a prevention, it is advisable to burn rusted or mildewed bean straw, and to plough the stubble deeply into the soil.

French Beans (including scarlet runner, haricot, kidney beans, and other varieties of genus Phaseolus). The parasitic fungi on these frequently resemble those on broad and field beans, but as a rule the fungus concerned belongs to a different species.

RUST.—This frequently injures scarlet runners and haricot beans, the foliage being covered with spores of a chocolate-brown colour (*Uromyces appendiculatus*).

BEAN ANTHRACNOSE OR POD-BLOTCH.—The young pods become blotched with sunken spots having a brown or reddish margin. If the spots are numerous the pods may become twisted, and growth is checked. The fungus (*Colletotrichum Lindemuthianum*) lives inside the tissues, and gives off tiny spores from the spotted places. It flourishes best where the beans are overcrowded in moist situations.

STEM ROT.—When ventilation is defective amongst crowded beans, the stem may become discoloured and rot a few inches above the ground, so that the plants wither away or become broken. This disease has been traced to fungi which live on decaying vegetable matter in the soil, and only become parasitic under favourable conditions, such as those presented by an overcrowded crop.

Treatment.—Spray with Bordeaux mixture (see FUNGICIDES) as soon as disease is suspected. This has been found so successful with pod-blotch, that its regular use is recommended. The first application is made when the beans are a few inches high, followed by a second ten days after, and a third when most of the pods begin to swell. There is reason to believe that diseased seed carries the fungus of the pod-blotch, hence only clean seed should be used. Diseased stems and pods left after collecting the crop should be burned.

[W. G. S.]

Beans, Statistics of.—Our knowledge of the extent of land cultivated for beans in the United Kingdom is derived only from the official returns of the past forty years When these returns were first collected, in 1866-7, an area somewhat under one acre in twenty of the surface under corn carried beans. The 548,000 ac. of the last of these years were rapidly extended to nearly 600,000 ac. by 1873, but thereafter somewhat remarkably declined, showing only an average area of 439,000 ac. over the five years 1876-80, and 335,000 ac. in 1886-90, dropping in the next decade to as low a point as 230,000 ac. in 1897—but thence, with some fluctuations, recovering, until ten years later, in 1907, a total of 311,000 ac. has been again recorded. The crop is very little grown in Ireland or in Wales, and only somewhat under 12,000 ac of beans are returned in Scotland, so that the English total of 296,000 ac. accounts for 95 per cent of the crop. Even here 76 per cent of the beans are grown on the eastern side of the country, the three counties Essex, Suffolk, and Lincoln alone accounting for over 100,000 ac. of the whole.

The average yield of the bean crop is quoted as 29·5 bus per acre, but the crops of 1906 and of 1907 both exceeded this average by quite 4 bus. per acre. In aggregate production a total of 1,258,500 qr. was estimated in 1906, and one of 1,340,000 qr in 1907. No official prices are quoted for beans, and the records of imports require a good deal of correction if attempted to be used for comparative purposes, owing to defective classification in the trade accounts until quite recently. Looking back to a period some thirty years ago, beans were returned in the aggregate imports as exceeding 3,000,000 cwt. annually, reaching 5,250,000 cwt. in 1894, the importation thenceforth declining again to a point below the first-quoted figure. Subsequently, by a correction of the returns omitting locust beans which in the previous years had been improperly included, a still further apparent reduction occurs, and after fluctuation more or less significant the imports of beans properly so-called fell to 634,000 cwt. in 1906, although the figures rise again to nearly 800,000 cwt. in 1907, Turkey being quoted as the source of more than half of the imports now received in the United Kingdom. [P. G. C.]

Bean Straw.—The straw or haulm of the bean plant is rather coarse in texture and of extremely variable nutritive value. If cut before the stem darkens and the hilum ('eye') of the seed turns black, it is decidedly more nutritious than cereal straw, and may even compare favourably with good meadow hay. This is especially the case with the upper portions of the stems, including the pods If cutting is delayed, however, until the crop is dead ripe, the straw will be of little value as food.

The available evidence on the composition of bean straw as commonly harvested in this country is very meagre. The averages on next column, from German analyses, are given by Kellner, and may serve as a guide. The digestible matter amounts on the average to 55 per cent of the total organic matter of the straw, and, assuming it to be of the above composition, will have an albuminoid ratio of 1 : 11½. 100 lb. of this straw will, according to Kellner, be equal for 'productive' purposes to about 19 lb. of starch, for maintenance to about 43 lb. of starch.

	Total	Digestible	Percentage digestibility
	per cent	per cent	per cent.
Water	18·4	—	—
Crude protein ('total albuminoids')	8·1	4·0	49
[Pure protein ('true albuminoids')]	[7·3?]	[3·2]	?
Ether extract ('oil')	1·1	0·5	57
Nitrogen-free extractives ('Soluble Carbohydrates', &c)	31·0	20·5	68
Crude fibre	36·0	15·5	43
Ash	5·4		

It will be noted that good bean straw is richer in protein, poorer in crude fibre, and in general—crude fibre excepted—more digestible than cereal straw. It requires greater caution in feeding, however, owing to its tendency to produce flatulence, especially if damp or mouldy. It is, moreover, far more susceptible than cereal straw to damage by moulds or fungi.

The *ash* of bean straw contains, as a rule, 30 to 35 per cent of potash (K_2O), 20 to 25 per cent of lime (CaO), and 5 to 8 per cent of phosphoric acid (P_2O_5) Unlike the ash of cereal straw, it contains very little silica (2 to 4 per cent) Assuming that only one-half of the nitrogen, and three-quarters of the phosphoric acid, but the whole of the potash contained in the straw consumed will reach the soil in the manure, the estimated value of the manure obtained by the consumption of 1 ton of bean straw of average composition will, at current unit prices, thus amount to about 15*s*.

For the purposes of *litter*, bean straw is greatly inferior to cereal straw, owing to its lower absorptive power for liquids and the slowness with which it disintegrates in the manure heap [C. C.]

Bean Tree, The Indian (*Catalpa bignonioides*), belongs to a genus of the nat. ord. Bignoniaceæ It includes four species, of which two tree forms are indigenous to the United States of America, and two small and unimportant shrub-like forms are found in Japan. Both of the American species are cultivated for ornament in Britain, and particularly in the warmer parts of the south of England, where their heart-shaped foliage and their long bean-pods contrast curiously with the surrounding trees. The name of the genus, Catalpa, arose from the fact that it was discovered by Catesby on the Catawba or Catalpa river, in parts of Georgia and Carolina occupied by Indian tribes of that name (hence also the common name of Indian Bean in Britain), though it is also popularly called the cigar tree from the appearance of its round, tapering, pendulous pods. The species cultivated in British parks and arboreta, and which is found to grow rapidly and thrive fairly well amid the smoke of large towns, is the *Catalpa bignonioides* indigenous to the Gulf States of America, and introduced here in 1726. It is a low and very branching tree, seldom attaining more than 30 to 40 ft. in height, but producing rich, light-green, heart-shaped deciduous foliage, and large terminal panicles of white flowers in profusion. Owing to its being a larger and handsomer tree, the other species, the Western Catalpa or Shawni Wood (*Catalpa speciosa*), is preferred for ornamental planting in America. The bean tree can be easily grown from seed or root-cuttings, and it is hardy in all the milder parts of Britain. [J. N.]

Bean Trefoil. See TREFOILS.

Beard, the bristle-shaped structure attached to the flowering glumes of numerous grasses.

Bearded Wheat Grass, a species of the Agropyrum or Couch genus of grasses. See COUCH.

Bearing Rein.—The abuse of the bearing rein has led to such fierce denunciations of it by well-meaning persons, that its proper employment may be forgotten. When adjusted to suit the particular animal for which it is required, it is effectual in keeping pullers in hand, and without it the inconvenience felt by the horse may be transferred to the arms of the driver to an extent calculated to paralyse his efforts at restraint. Bits and other contrivances have, of course, similar objections when unnecessarily severe or when used without judgment and solely for the purpose of appearance and display. Pairs are kept together better by its use, and accidents prevented in the case of 'fresh' young horses. In the case of heavy draught horses the bearing rein is seldom justifiable, and is absolutely opposed to the principles of draught. A horse with a load should be able to lower his head in order to exert himself at his best, but some cross-bred and heavy-headed animals are in greater danger of falling upon their knees when not compelled to carry themselves with due attention. The bearing rein is attached by buckles to a jointed snaffle bit, which is independent of the driving bit, and looped or buckled behind the hook or other more or less ornamental contrivance fastened to the harness saddle or pad. In the case of cart horses it is usually thrown over the hames. [H. L.]

Beast.- This term is used in a general sense to designate all such quadrupeds or four-footed animals as are made use of for food or employed in labour; but farmers speak of 'beasts' more especially with reference to bullocks or other cattle. [J. B.]

Beast Gate or **Cattle Gate,** in England, means either (1) the amount of pasture sufficient for one beast, grass for one cow being equal to that for five sheep, and three cattle gates being equal to pasture for two horses; or (2) the right of common pasturage for one beast. See COMMON. [D. B.]

Beaver (*Castor fiber*), the largest rodent now existing in the northern hemisphere. It is a brownish furred animal, about 2½ ft. in length. The head is broad and massive, with powerful jaws, and, in adaptation to the semi-subterranean life, the external ears are short and can be folded over the opening, the eyes are small, and the nostrils can be closed at will. The tail differs from that of all other rodents, being flat and scale-covered; the fore legs are short and strong, with an accessory bone in the wrist, and strong digging claws on the five toes; the hind legs are somewhat longer, and the toes are webbed to their tips. The incisor teeth, which have bright orange-coloured enamel, wear away more quickly behind than in front, leaving a sharp chisel-like cutting edge; they grow from persistent pulp, and are thus continually being renewed from the roots. The grinding teeth (premolars and molars) have several infoldings of enamel. The dental formula is—incisors $\frac{1}{1}$, premolars $\frac{4}{4}$, molars $\frac{3}{3}$

Beavers appear to have been fairly numerous in Britain in very early times, at least in Scotland and Wales, but to have gradually diminished under constant persecution, and finally to have disappeared. Their existence is recorded in Wales till the thirteenth century, and in Scotland to a somewhat later date. Since then the beaver has only been known in Britain in a state of captivity. The Marquis of Bute reintroduced them into the island of Bute, but they died out again. An interesting colony has been kept for some years in Sussex by Sir H. E. Loder, and there all the beaver's characteristic activities of tree-felling, dam-constructing, and lodge-building may be observed. A few beavers are believed to live in some parts of France and Germany, in Norway, and on the Danube; but they are apparently decreasing in number. It is only in Canada and in a few far western parts of the United States that beavers still exist in sufficiently large numbers to be of commercial importance, or to have any effect on the configuration of the country. The American beaver differs very slightly from the European, and is usually regarded as a mere variety.

Beavers dig their burrows along the river banks, with the openings under water. They gnaw down trees, often 10 in. in thickness. After eating off the bark, they cut the trunk into logs, and pile these up to form a dam, plastering them with mud, which is carried between their forefeet. In his American Beavers and their Work (1868) Mr. Lewis Morgan describes a dam about three-quarters of a mile in length, of which one-third had been entirely constructed by the beavers, while the rest was natural bank strengthened in parts with logs. As the water—deepened by the dam—rises in the burrows the lower part is filled up with chips, and the earth is hollowed out above, and thus the 'lodge' evolves, almost automatically. There are different types of lodges, varying with the situation, but notwithstanding its effectiveness as a builder, the beaver cannot be considered a very intelligent animal. Most of the tales which have led to its reputation for great cleverness are either misstatements or misinterpretations.

The fur of the beaver consists of a short, soft, silky underfur interspersed with long, stiff, almost bristle-like hairs. These long hairs are pulled out or cut short, and the underfur forms the beautiful 'beaver' of commerce. Beaver skins were formerly much used in the manufacture of hats, but pure beaver-felt is now almost unknown. Only the inferior or damaged skins are used, and the hair is supplemented by the fur of hares, rabbits, &c., which indeed often replaces it altogether. The castoreum, which is the oily, highly odoriferous secretion of preputial and anal glands, is still sought after, but is no longer so highly valued as in olden times, when an almost magical healing virtue was ascribed to it. Beavers are caught chiefly by means of traps. Their flesh, though oily, is said to be relished by the trappers, a special dainty being the fat tail of a beaver which has fed on water-lily roots. [J. A. T.]

Bedding, the material used in making a bed for animals to lie on. See Litter.

Bedding Plants.—The arrangement of certain plants in flower beds in some kind of pattern or design has come to be known as bedding out. When the design is flat like a carpet or panel, it is styled carpet bedding. Less pretentious arrangements are known as spring or summer bedding, according to the time when the display is at its best. Twenty years ago carpet bedding was much more popular than it is now. It is felt by people of taste that such an arrangement of plants was, to say the least, inartistic, and certainly unnatural; whilst the arrangement of the colours, generally done without any attention to harmony of shades, often resulted in an effect that was anything but agreeable. Whilst, however, this kind of bedding is condemned as a misuse of plants, the plants themselves are worthy of a place in the garden, and when the arrangement is of a simple character such plants produce a pleasing effect A bed in a conspicuous place on a lawn, filled entirely with Scarlet Geranium, Heliotrope, Verbena, or Begonia, or with a simple mixture of several different things that harmonize, such as violas with white geraniums, Alyssum with Scarlet Begonia, or a mixture of yellow and brown Calceolaria, is worthy of the most select style of gardening It is when the mixtures are opposed to the recognized rules with regard to colour, such as Blue Lobelia as an edging to Yellow Calceolaria or Scarlet Geranium, that bedding becomes ugly. The present fashion of gardening is in favour of beds and borders cut out in or surrounding stretches of smooth green lawn, and it is therefore desirable that the plants used for filling such beds and borders should be not only suitable with respect to habit and colour, but also sufficiently lasting to maintain the desired effect as long as possible Summer bedding is therefore an arrangement of free flowering or coloured-leaved plants that will look well from June till the end of September Many hardy plants may be used for the purpose; annuals also with a little management may play an important part in summer bedding. The popular favourites are, however, more or less tender, and therefore require protection in frames or greenhouses during cold weather. Such plants are Geraniums, Fuchsias, Begonias, Calceolarias, Heliotropes, Ageratums, Verbenas, Dahlias, Gazanias, Gladioluses, Lantanas, Lobelias, Petunias, Salvias, and Chrysanthemums. The ornamental-leaved plants that are used for bedding are Coleuses, Centaureas, Iresines, Alternantheras, Cerastiums, Echeverias, Pyrethrum (Golden Feather), Sempervivums, and various succulents. Hardy perennials which are useful for this purpose are Antirrhinums, Gaillardias, *Helenium pumilum*, Pentstemons, Violas, Carnations, Pinks, Erigerons, Lavender, Pyrethrums, Scabiosas, *Alyssum saxatile*, and *Arabis alpina*. Annuals that may be used are: China Asters, Stocks, Sweet Peas, *Phlox Drummondii*, *Delphinium ajacis*, Marigolds, Zinnias, Centaureas, *Chrysanthemum coronarium*, Godetias, Eschscholtzias, Iberis, Mallows, Lupins, Mimulus, Nemophilus, Nicotianas, Nigellas, Poppies, Portulacas, Mignonette, Salpiglossis, Scabiosas, and Tropæolums. Spring bedding consists of an arrangement of bulbs such as Tulips, Hyacinths, Muscaris, Crocuses, Daffodils, and Chionodoxas, and spring-flowering hardy herbaceous plants such as Wallflowers, Polyanthuses, Doronicums, Auriculas, Aubretias, Forget-me-nots, Pæonies, Pinks, Anemones, Turban Ranunculuses, and Pansies.

[W. W.]

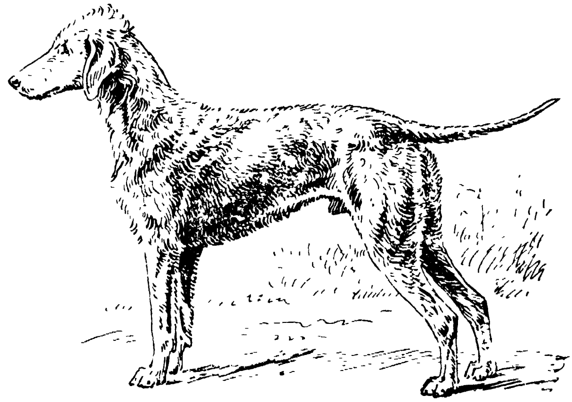
Bedford Level.—The Bedford Level is a large extent of flat and very fertile fen-land in the counties of Northampton, Norfolk, Suffolk, Lincoln, Cambridge, and Huntingdon, and the Isle of Ely, comprising over 300,000 ac., which has been reclaimed from its original condition of swampy marsh It is so called from the agreement made by Francis, Earl of Bedford, and other 'adventurers' in 1634 with Charles I for the drainage of the Level, in consideration of receiving 95,000 ac of the reclaimed land In 1663, when the original drainage works had been finished, the Act 15 Chas. II, c. 17 was passed, which constituted William, Earl of Bedford, son of the said Francis, and his co-adventurers a corporation under the name of 'The Governor, Bailiffs, and Commonalty of the Company of the Conservators of the Great Level of the Fens', with power to levy taxes from time to time for the support, maintenance, and preservation of the said Great Level. By section 5 of that Act the governor, bailiffs, and conservators were constituted commissioners of sewers for the Great Level, five or more to form a quorum, with authority touching all matters and things within the Level or the works made without the Level enquirable, punishable, or to be done by commissioners of sewers. By section 8 it was enacted that no lease, grant, or conveyance of or charge out of or upon the said 95,000 ac. allotted to the Earl of Bedford and his co-adventurers, or any part thereof, except leases for seven years or under, in possession, should be of force but from the time it should be entered with the registrar of the Level in the Fen Office. It has been held that want of registration of deeds does not avoid them as between the parties thereto themselves, and that unregistered conveyances are valid for all purposes except for entitling the grantees to the privileges conferred by the Act on the owners of lands within the level, and for the other purposes of the Act (see Hodson *v.* Sharpe, 1808, 10 East, 350; Willis *v.* Brown, 1839, 10 Sim. 127).

The governors, bailiffs, and conservators are elected annually in Whitsun week, and no one may be a governor or bailiff who has not 400 ac., or a conservator who has not 200 ac., nor may any of the commonalty have a voice in the election who has not 100 ac. (section 15).

The expenses of the corporation are raised by taxes which, under the Tax Act 20 Chas. II, c. 8, vary according to the value of the land.

The Level is divided into the North Level, Middle Level, and South Level. Since the original constitution of the corporation, extensive additional works have been carried out under the authority of various Acts of Parliament to complete and improve the drainage of the district. [A. J. S.]

Bedfordshire Pigs.—Within the memory of the writer the county of Bedford occupied a position of some importance in the porcine world — a position which it has lamentably failed to retain during the two recent decades. About half a century since, the pigs in this county were of a type very similar to those found in the Fens of Cambridgeshire, being large and somewhat coarse in bone, hair, and flesh, of a colour mainly white, with more or less of blue markings on the skin, which last lacked fineness; the hair was inclined to be curly, but not to so large an extent as that of the pigs found in the Lincolnshire and Norfolk Fens, and to a limited extent in the northern part of the Isle of Ely. The heads were somewhat long, as were the ears, which were pendent to such an extent as frequently to obscure the sight of the pig, much after the style of the newly discovered Large Black pig of Cornwall and Essex The body was deep and very muscular, whilst the fattening of the pig not being completed until it had reached at least one and a half years, resulted in a heavy carcass, furnishing a considerable proportion of rather hard lean meat, suitable for conversion into those huge flitches of bacon which graced the roofs of the farmhouses in the Fens and furnished a good, albeit somewhat strong, supply of food for the households, which usually comprised a certain number of farm 'hands' in addition to the family of the farmer. The establishment of at least one fair-sized herd of Yorkshire pigs, and the growth of a very considerable trade in store pigs, which were distributed pretty well all over the British Isles, together gradually but surely changed the type of pig bred in the county, until the old Bedfordshire pig of the middle of the last century had disappeared. A few of these pigs were exported to the States, and it is said were used in the upbuilding of one of the present breeds of pigs in America; but the complete change in the form and quality of the fat pigs required in the home markets rendered other types of pigs of more general commercial value. [S. S.]


Bedlington Terrier

Bedford Willow. See Willow.

Bedlington Terrier.—Although the existence of the Bedlington Terrier has been a recognized fact amongst dog lovers for quite a hundred years, it was not until about the year 1870 that the merits of the breed became known beyond the limits of Northumberland and the adjacent districts. Up to that time the terrier in question had enjoyed a great reputation as a vermin dog, and particularly as a worker in water, amongst the pitmen of the Bedlington district, who appreciated its merits as highly as they admired its peculiar form of beauty. At one time, moreover, it appeared as though the breed would become a general favourite amongst the dog-owners of the country, and unquestionably the courage of the Bedlington Terrier, his great value as a vermin dog, and the robustness of his constitution should combine to make him popular, but he somehow has failed to create the impression that was expected of him.

Possibly the fact that the disposition of the variety is a little uncertain may have alienated the goodwill of the public; but so far as the exhibitors of dogs are concerned, there can be no doubt but that their absence of appreciation of the Bedlington is mainly due to the fact that the coats of the show dogs are invariably so plucked and trimmed before the animals enter the ring that the amateur exhibitor can stand but little chance of winning a prize with his dogs. It cannot of course be suggested that there is any unfairness in connection with a practice such as the above, for it is adopted openly, but it is not everybody who has the time to devote to the manipulation of his dog's coat; and there are plenty of those who possess such leisure and who yet do not approve of exhibiting trimmed dogs.

As a consequence, the Bedlington Terrier bases such popularity as he enjoys upon what merits he may possess as a working dog, and beyond all question he appeals very strongly to all country residents and agriculturists in this respect. There is no gamer terrier bred than a good Bedlington, and not the least of his merits is that he is as keen a vermin dog in water as he is on land. Hence the remarkable popularity that he has acquired amongst the hardy pitmen of the north, who are quite prepared to excuse his natural infirmity of temper on account of his gameness and his value as a working terrier.

The ancestry of the Bedlington Terrier is difficult to trace, and probably were the whole truth to be known there were several varieties concerned in the establishment of the line. The breed, moreover, possesses several characteristics which are peculiarly its own, conspicuous amongst these being the pronounced tendency towards flat-sidedness that exists in connection with the breed. In the case of almost all the other varieties of the canine race the ribs behind the forearms should be nicely sprung, but with the Bedlington Terrier it is just the reverse, as it is required that his sides should be flat. The unusual formation does not, however, affect his working capacity to the slightest extent, as there is no variety of dog that can get through more in a day than a Bedlington, and as his constitution is of the very best it is abundantly certain that the flat sides of this courageous dog have not in the smallest degree prejudiced his value or his utility

The skull of the Bedlington Terrier is rather narrow and decidedly domed in shape, in which respect he differs from most of the members of the family. The domed shape, moreover, is rather exaggerated in appearance by the top knot of soft, silky hair which adorns the top of the head, both of the peculiarities referred to being shared by the Dandie Dinmont Terrier. The muzzle is long, the jaws being of unusual strength so as to ensure that amount of punishing power which renders the Bedlington a terror to all sorts of vermin, and the teeth are large and well developed, many good specimens of the breed being overhung or pig-jawed—a formation that necessitates their upper teeth projecting beyond the lower ones The nose is large and moist, its colour following the shade of the dog's coat, as does that of the eyes, the lighter-coloured specimens possessing light-coloured noses and eyes, whilst in the dark ones the reverse is the case. The ears are of a good size, and lie flat to the sides of the head, they should be set on rather high and be of a filbert shape, whilst the neck is long and powerful, but graceful-looking, and it should be set on to long, sloping shoulders, for the Bedlington is a variety that possesses both activity and speed in abundance

The body is well let down behind the forearms, and thereby affords room for the heart and lungs to work in, which would otherwise be denied them owing to the narrow chest and flat ribs, which are characteristics of the breed. The back is a little arched, and the loins inclined to be tucked up, which, combined with the long forelegs, gives the breed a somewhat leggy appearance. The tail is long and tapering, and it should be carried rather low and never over the back. The coat of the Bedlington Terrier is far more weather-resisting than it appears, it being less harsh than that of most of the varieties which take kindly to water,—in fact it belongs more to the pily than to the wiry order of things. As regards the question of colour, it may be stated that those most preferred are blue or liver of a rather light shade, but an admixture of tan with either of them is not uncommon, and is not regarded as any objection. Twenty-five pounds is a good average weight for a full-grown dog, the bitches scaling about two pounds less. This renders it difficult for a Bedlington Terrier to enter some earths which are only accessible to smaller dogs, but in spite of the fact a better all-round or more courageous working terrier does not exist.

[V. S.]

Bedstraw.—This name is applied to weeds belonging to the genus Galium and the nat. ord. Rubiaceæ. These weeds are easily recognized by the rough, angular stems and the narrow leaves arranged in whorls. The white or yellow corolla of the flower is very short and four-lobed The ovary is on the outside of the flower, and when ripe it splits into two pieces, each containing one seed.

White Water Bedstraw (*Galium palustre*).—Absence of hair is characteristic of this species. The leaves are in whorls of four, and the flowers are white Moist meadows and ditches are the natural habitats of this perennial weed.

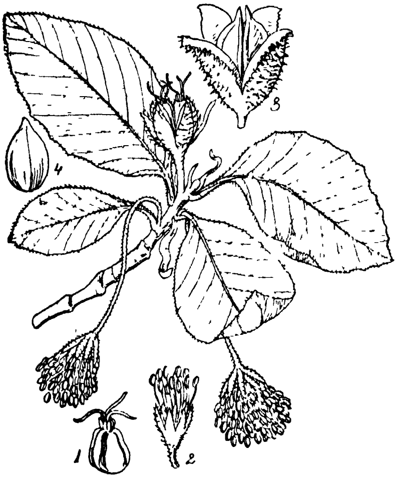
Smooth Heath Bedstraw (*Galium saxatile*) is another white-flowered perennial weed found naturally on dry, hilly land. It is distinguished by the trailing stem, and the leaves in whorls of six

Yellow Bedstraw or Lady's Bedstraw (*Galium verum*)—This perennial is readily distinguished by its clusters of small yellow flowers, and by the leaves, eight in a whorl. It grows upon sand and chalk, but not on heavy clay, and is very common on dry banks by waysides As a weed it indicates poor, dry, hungry land. Yellow bedstraw is sometimes called *Cheese Rennet* from its property of coagulating milk. This plant grows in Iceland, and there a good yellow dye is extracted from the herbage by macerating in alum water The following statement summarizes the distinctive points of the bedstraw weeds

White Water Bedstraw	flowers	white,	leaves in	fours
Smooth Heath	,,	,,	,, ,	sixes
Yellow	,,	yellow.	,,	eights

[A N M‘A]

Beech (Fagus), a genus of the Cupuliferæ (nat. ord Amentaceæ, or ‘catkin-bearers’), the other genera of which include the oak and the chestnut. It differs from these in having its female flowers in separate terminal bunches, in having male catkins with a long petiole and hanging down from the side, and in having a hard prickly cupule or involucre opening in four valves, and containing two or three three-cornered, sharply-pointed nuts, commonly called ‘mast’ The only species indigenous to England, and introduced into Scotland and Ireland, where it thrives very well, the Common Beech (*F. sylvatica*), is a tall tree, with a straight, smooth trunk, and large head, densely foliaged, with ovate, glabrous, entire or obscurely toothed leaves, pale-green and ciliated along their margin while young and tender, but becoming darker and tougher after early spring is over. It is indigenous to most of the temperate parts of Europe, and often forms extensive woodlands, which perhaps attain their finest development on the low hills of central Germany. It is now, and probably always has been, the chief woodland tree on the long range of chalk hills forming the watershed of southern England, where the scattered remnants of the primeval woods occur as small blocks of highwoods on the Chiltern, Cotswold, and other hill ranges in Bucks, Berks, Dorset, Hants, and Wilts, its finest growth being usually attained in Bucks. In ancient times beech-mast was, like the acorn crop, of great importance for the pannage of swine in the woodlands. It is still largely used for fattening pigs, but exclusive mast-feeding is apt to produce *garget*. Although one of the most shade-enduring of our trees, it has never in England been cultivated largely as coppice, as other kinds of underwood (oak, ash, hazel, &c.) not only shoot more freely from the stool, but have also always been of greater utility and value when small. It was, however, one of the four other kinds of tree ('elm, ash, asp, or beech') ordered by the 'Statute of Woods', 1543 (see ARBORICULTURE), to be selected for storing as standards in copses in default of oak. Thickly foliaged, it throws a dense shade on the soil beneath it, so that below the close canopy of highwoods few shrubs or grasses can thrive, and the ground is thickly carpeted with dead foliage, which forms good humus or mould rich in potash. Grown closely, it develops a long, straight, columnar bole, with smooth, grey-green bark, and presents charming glade-like vistas between the stems, above which is borne a thick mass of foliage, equally beautiful in its summer verdure or in its autumn russet. Owing to its heavy shade and drip, and its lateral expansion when growing isolated, it is a tree entirely unsuited to hedgerows; but in parks its massive expanse of beautiful foliage and its wide-spreading, umbrageous branches, reaching down to near the ground, make it highly ornamental. Close-clipped, it forms a good hedge for park or garden.



Beech (*Fagus sylvatica*).—Leaves and Inflorescence

1, Ovary, 2, Male flower, 3, Capsule, 4, Fruit

Impregnated with creosote, its wood is largely used for sleepers in France; but its timber contains more albuminoid matter than most of our other hardwoods, and it is therefore, though hard and solid (sp. gr. 1·01 green, 0·75 seasoned), more apt to be attacked by destructive insects and fungi, and to prove much less durable than these under ordinary conditions of use when exposed to the open air. And this is more especially the case if trees are summer-felled. Under water, however, it is durable for mill and sluice work; and it is also used for turnery, box-planes, and other tools, and for wheels and cartwrights' work. But its chief use is in the making of kitchen chairs and bent-wood furniture, and a great industry in chair-making has for centuries been carried on in the beech tracts of the Chilterns, having its centre in and around High Wycombe (Bucks), though the local woodlands have long failed to supply all the raw material required, and this trade is now, unfortunately, mainly dependent on imports of foreign wood.

On the Continent, where its growth is of great importance for domestic fuel, beech only thrives well on a fairly good and fresh sandy-loamy or limy soil, but in Britain its growth as a timber crop is almost entirely confined to the chalk hills, and, to a much less extent, to other dry and often light soil; and it thrives well within the influence of sea air. The customary Bucks method of regenerating the highwoods that have grown there from time immemorial is casual rather than systematic. Partial clearances are made every 15 to 20 or 30 years, when marketable timber is felled and removed to the extent the owner or agent considers desirable. Spontaneous regeneration is then awaited from the beech-mast on the recurrence of good seed production every 5 to 7 years (1900 and 1906 gave good mast), and the whole is left to grow up till the next partial fall of mature timber is decided upon. Where the woodlands are sufficiently extensive better results might easily be obtained by soil-preparation in the winter before a good mast year (which can be foretold by the thickening of the flowering buds on the twigs), and by adopting the continental system of dividing the woods into (say) five periodic blocks, varying from 0–20, 21–40, 41–60, 61–80, and 81–100 years of age, and commencing and continuing gradual fellings for 20 years in the oldest block till all the mature timber was removed, and the young crop averaged 0–20 = 10 years of age. Natural regeneration of beech is preferable to planting, as for the first few years the young growth requires the shelter of the parent trees (or of other nurses) against strong direct sunlight and hard frost. Nursery plants for ornamental or other purposes can easily be raised from seed by collecting the mast in autumn during dry weather, storing it in a dry, cool, airy place, occasionally turning it over through winter, and sowing in spring. One pound contains about 2000 seeds, and may be expected to produce about 1000 to 1200 seedlings.

The seedlings are sometimes liable to be largely attacked and destroyed by the fungous disease (see next article), but otherwise the beech has not much to suffer from pests, although stems are sometimes cankered by *Nectria ditissima*, and white rot is caused by *Fomes fomentarius*; while among insects the larvæ of the beetle *Orchestes fagi*, which mine in the leaves, and the felted scale (*Cryptococcus fagi*) on the bark, are in Britain the most dangerous enemies. The beech scale is now a very serious and destructive pest on ornamental and other trees in many parts of Britain, and trees badly attacked soon become moribund.

Among the several purely ornamental varieties of this tree, the Copper Beech (*F. s. atropurpurea*) is the chief. It is largely cultivated in parks and gardens on account of its rich, dense, dark-red to purplish-brown foliage, which affords a very effective contrast to the ordinary green foliage of other trees.

[J. N.]

Beech.—Parasitic Fungi.—Seedling Disease. Seedlings are killed off in large numbers by the Beech Seedling Mildew (*Phytophthora omnivora*), a relative of the Potato Mildew. The disease may also attack seedlings of conifers and other trees. The symptoms are dark blotches on the leaves and stems, accompanied by a whitish mould. The plants may recover if vigorous, but the disease is frequently epidemic and spreads rapidly from plant to plant. Spores are given off, and in moist conditions the contents break up into several smaller spores with two whip-like locomotory cilia; these swarm-spores swim in drops or films of water, and settling down give off a short tube, which pierces a leaf and infects the plant. After the seedlings are killed, thick-walled resting-spores or eggs are formed, and these can survive in the soil for several years.

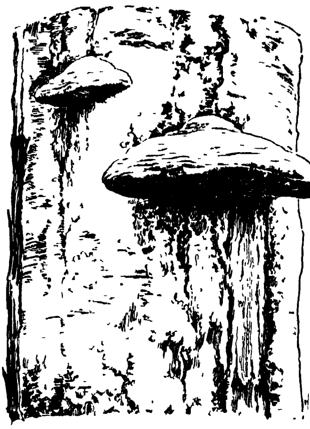
Treatment.—Diseased seedlings should be carefully uprooted and burned. At the same time, everything possible should be done to allow free access of air and sunshine; it is also advisable to thin out the seedlings where crowded. If the disease attacks a nursery bed severely, it should be given up for tree seedlings and utilized for some other crop, because the resting-spores will almost certainly infect seeds of trees sown there again.

The damping off of tree seedlings may also be caused by other fungi. A brown mould (*Pestalozzia Hartigii*), which attacks the stem just above the surface of the soil, is common in seed beds of beech, ash, sycamore, and conifers (see Pine Seedling Disease). The common damping-off fungus (Pythium) may also attack tree seedlings (see Fungi).

Stem Canker.—Young beech trees are frequently attacked by canker, due to the entrance of the Canker Fungus (*Nectria ditissima*) into wounds, and much damage may be done. See Apple—Parasitic Fungi.

Wood Rot.—The large hoof-like or bracket-shaped fruit bodies of several species of Polypores are frequently seen on beech, especially when the trees are old or have been broken by wind. The most common of these is the Tinder Fungus (*Polyporus fomentarius*), so called because the soft spongy tissue inside the fruit bodies was used to catch the spark from the flint and steel of the old tinder-boxes. They are also familiar from their use as razor strops. These fruit bodies are a sign that wood rot is in progress inside the stem, and in some districts much damage is caused. Wood rot may also result from attacks of certain mushroom fungi. These live first on dead wood or tree stools, but may find an entrance into living beech and other trees by wounds on the roots. See Pine—Parasitic Fungi.

Treatment.—Trees showing fruit bodies of Polypores or mushroom fungi should be felled off, as they will deteriorate more the longer they are left. The application of tar to any wounds observed on the trees will prevent the spores of these wood-rot fungi from gaining an entrance.



Polyporus fomentarius on living Beech (after photograph by v. Tubeuf)

Green Wood.—Dead beech timber frequently assumes a peculiar greenish colour through the action of fungi. Some forms of this wood are very hard, and are valued for decorative work.

Root Rot. Like most other trees, beech may be attacked by fungi which set up rotting of the root. In the plantation, root rot is probably a sign of defective drainage. In the nursery, the trees should be dug out and burned with all the soil round their roots, and the hole filled in with clean soil mixed with quicklime.

[W. G. S.]

Beef.—Beef is the flesh of oxen, heifers, cows, and bulls, the meat of the former two being looked upon as first-class or prime according to quality, while the meat of the latter two is classed as second and third-rate, depending on whether the animals had been well fed, and on their age. The lean or muscular tissue of young animals should be of a pale-red colour, and as the animal becomes older the meat gets brighter red, while in old age it gets a darker red. In the tissue of the limbs there is, except in very well-nourished animals, rarely any intermuscular fat, while in other parts of the body, especially in the so-called 'roasting parts', there is so much intermuscular fat that prime roast beef presents a marbled appearance. On section the consistence should be firm yet elastic, and not doughy. There should be a fair amount of natural moisture in it, but not too much, as an excess will indicate either some dropsical disease or that the meat is from a frozen carcass which is undergoing the process of thawing out. The grain of beef should be fine, though this varies in the different parts of the body, being finest in the so-called 'undercut' or psoras muscles, and coarser in the neck, breast, or brisket, and lower parts of the limbs, but age and sex must also be considered, the grain of old and badly-fed animals being much coarser. This is specially seen in old bulls, where the grain is sometimes so coarse as to resemble that of horse flesh. The fat, or adipose tissue, of beef varies in colour, being whitish, biscuit or straw coloured, and even yellow, depending on the age, health, and breed of the animal. The yellow colour is seen in breeds such as Guernseys, Jerseys, and occasionally in home-fed cattle, but the colour may be due to disease in the animal, as in the flesh of oxen that have suffered from jaundice, redwater, &c. Good beef should have a pleasant smell, and on exposure to a strong heat should give out a savoury odour. Bull beef generally shows little subcutaneous or intermuscular fat, the muscular tissue being exceptionally well developed. On the other hand, the meat of well-fed cows is quite the opposite, there being a great increase of the fat or adipose tissue with only a moderate increase of the muscular tissue, the subcutaneous and perirenal or sublumbar fat being very plentiful.

As a very great percentage of beef sold in butchers' shops at the present time is imported from foreign countries, for the benefit of the purchaser a brief description of how to distinguish imported meat may be useful, but it must be borne in mind that in many cases it will take an expert to decide the difference. Frozen meat may be detected when it has lately come out of the refrigerator or ice-box, more especially if the atmosphere is warm, by passing the hand over the carcass, when it will feel damp, and may even be wet. On section the meat is stiff and inelastic, shows the presence of ice in it, and soon takes on a glistening appearance, due to the moisture exuding from it, thus causing the surface of the section to feel smooth, slippery, and wet. This condition lasts for some time, depending on the temperature of the shop or place in which the meat is hanging, and if the temperature be high the moisture may almost run out of the meat. Gradually the muscular tissue assumes a bright-red appearance, changing later to a dull dark colour, gets doughy and inelastic, also feels sticky, and pits on pressure. Later it becomes still darker, and may even be unsightly-looking, though decomposition has not yet set in. The fat on section at first appears firm and white in colour, but gradually gets stained a pinkish red, due to the colouring matter (hæmoglobin) exuding along with the moisture from the muscular tissue and running over it, while it pits on pressure and has a tallowy feeling.

Chilled meat has somewhat similar characters to that of frozen meat, but in a much less degree, as it has not been subjected to so low a temperature. Therefore not so much moisture exudes from it, and hence there is less colouring matter, also less staining of the fat. Indeed, in the best class of chilled meat, kept clean and carefully handled, also where care is taken so that the change from the refrigerator into a high temperature is not too rapid, that is to say, where the thawing out is done by slowly increasing the temperature of the place in which the meat is kept, only an expert can tell the difference between it and home-killed meat that the butcher has kept in his ice-box during summer weather. The fat of chilled meat on section has a more greasy feeling than that of frozen meat, though not so much so as that of home-killed meat, and a noticeable feature of chilled meat is that it resists decomposition for a considerable time. For that reason, and the fact that being kept for some time it eats tender, it sometimes during summer weather commands as good a price as home-killed meat.

Defrosted meat is frozen meat which has gone through a special process of thawing out. The carcasses of mutton or quarters of beef are put into specially fitted chambers, the temperature of which is gradually raised by means of steam pipes laid along the bottom of the chamber, while the moisture exuding from the carcasses is carried away by being collected on coils of pipes containing ammonia, fitted up the sides of the chamber. Thus the carcasses, being subjected to very gradually increasing temperature, are at last brought up to near that of the external air, say between 50° and 60° F., the result being that, on exposure in the market or shop, the warm atmosphere does not condense on them, the ice being all out of them. On section the tissues are nearer in appearance to that of home-killed meat, though some experts are of opinion that they are somewhat like as if they had been partly cooked. This is denied by others. An important feature is that there is almost no staining of the fat, the gradual withdrawal of moisture evidently not bringing out the colouring matter. During 1907 the improvement was tried of sterilizing the air of refrigerating chambers in which meat is brought from abroad. By this means it is hoped the growth of fungi, often seen on imported meat and rendering it unsaleable, will be prevented; and thus meat coming long distances, as from the Argentine, will arrive free from this objection. Not only so, but to try and prevent this there has been a tendency to keep the temperature of the refrigerators very low. Thus the meat got a lot of ice in it, and in that way its value was reduced. By this new process the difficulty would be overcome, the meat being carried in a temperature never rising above 34° F. or below 29° F., the mean being about 31·5° F. The following experiment may help to show the effect of this treatment. A quarter of beef was put into a refrigerator on the 13th day of November, 1907, and kept, under the new process, at a uniform temperature of 31° F. for two months. When taken out, the meat, on being cut, showed that it retained its brightness of colour and juicy freshness, while the flavour on cooking was excellent. Should this be the result in the case of seaborne cargoes, we are on the eve of a revolution in the importation of meat. (The patentees are the Universal Sterilization Co., Ltd., New Bridge Street, London, E.C.) Thus the British farmer will have keener competition to meet instead of less

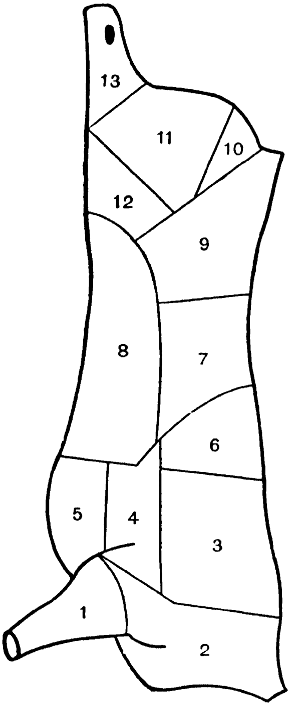


Fig 1 —Diagram showing London Method of Cutting up side of Carcass of Bullock (by T D Young, London)

1, Shin 2, Clod and sticking piece 3, Back ribs 4, Top ribs 5, Briskets 6, Fore rib or wing rib 7, Sirloin 8, Flank 9, Rump 10, Aitchbone 11, Buttock (including top side and silver side) 12, Thick flank 13, Leg

The cutting up of carcasses of beef into joints is difficult to explain, as the butchers in England, Scotland, and Ireland have each their own methods, and even within a radius of 50 miles or less, different methods are adopted and different names given to the various joints However, the accompanying diagrams show the London (English) method, Glasgow (Scottish) method, and Dublin (Irish) method

[T. D. Y]

Some Methods of Preserving Beef.—In the curing of beef and other meats on the farm, a room reserved for the purpose and a few simple appliances are desirable. The room should be clean, cool, and dark. Cleanliness is imperative, and coolness and darkness obviate danger from flies. An underground chamber is best if not too damp and if well ventilated, a still atmosphere being fatal to curing. It will be found useful to have an elevated curing platform along one side of the room, 3 ft. wide and 2 ft. from the ground, upon which certain meats can be cured in a dry state.

A row of tanks on the opposite side of the room is also necessary, or an oak pickling tub can be substituted at less cost A still cheaper plan would be to use half barrels, and provided they are perfectly clean there is no reason why success in curing may not be attained with them as well as in oak pickling tubs

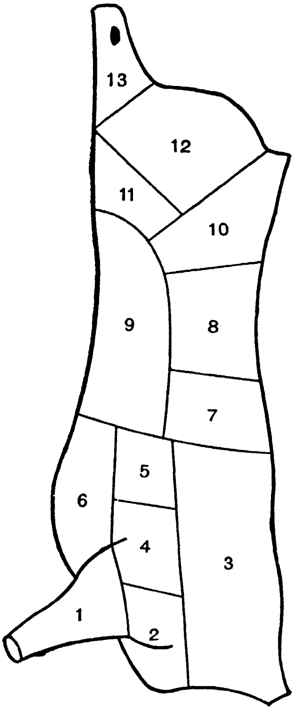


Fig 2 - Diagram showing Glasgow Method of Cutting up side of Carcass of Bullock (by A Hynd, Glasgow)

1, Fore hough 2, Gullet 3, Shoulder 4, Thick runner 5, Thin runner 6 Brisket 7, Rib cut or Scotch roast 8, Sirloin or English cut 9, Flank 10, Pope's eye 11, Fleshy end or beef-tea meat 12, Round or rump 13, Hind hough

It is also necessary to have an instrument for testing the pickle. The old-fashioned way was to make the pickle strong enough to float a potato or a pig's foot, but that is a very casual way of arriving at the density of any liquid. Hence a salinometer has been devised, which is a simple instrument by which the exact density of any curing pickle can be ascertained at once.

Another appliance which will be found of great service is a pickle pump. A convenient form for small users is in the shape of a hand syringe, and by this instrument the pickle is forced into meat at will.

For handling the meat in a cleanly way it is necessary to have a meat trough, which is made of iron, and which is enamelled white on the inside. Such a trough is useful in many ways, and it can always, without any great trouble, be kept perfectly clean owing to its enamelled surface.

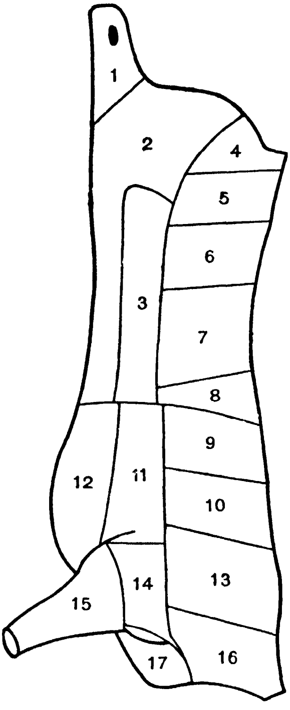


Fig 3 Diagram showing Dublin Method of Cutting up side of Carcass of Bullock (by Mr Geogehan, Dublin)

1, Leg 2, Round 3 Lap 4, Tail end 5, Side cut. 6, Chump or jump 7, Centre sirloin 8, Point of sirloin or wing rib 9, Fine ribs 10, Blade ribs 11, Plate ribs 12, Brisket 13 Chuck 14, Shoulder 15, Shank 16, Scrag 17, Sticking piece

With these few appliances, and, of course, the various accessories in the way of knives, a good saw, a chopper, and a good steel, the curing house on the farm may be reckoned to be complete.

There are two ways of curing, the dry and the wet cure.

The dry curing of such articles as pork, hams, bacon, and beef briskets is conducted in the following way:—

In the first place a pickle has to be prepared, as in thick sections of meat it is necessary to thoroughly charge the muscles with the curing pickle.

To prepare the pickle referred to, take the following ingredients.—

55 lb. salt,
5 lb. pure cane sugar,
5 lb saltpetre,
5 lb. dry antiseptic or any other boron
preservative.

Make the whole up to 20 gal. with clean fresh water. Boil this mixture, stirring the while, and remove from the surface any scum which may be there. The boiling may be conducted in the ordinary farm copper When the liquid seems to be fairly clean, remove it into a clean barrel, and allow it to settle and cool to the same temperature as the surrounding atmosphere This pickle should test 100° on the salinometer already referred to, and is the curing pickle which is used throughout the various processes It is sometimes considered desirable to add such ingredients as Jamaica pepper, coriander seeds, juniper berries, laurel leaves, and similar vegetable flavouring substances. The addition of these, however, is purely a matter of taste.

Prepare the platform for dry curing by placing over it a layer of salt, and on top of this the sections of meat or pork may be placed First of all, proceed to inject the pickle in many places by means of the hand syringe referred to; sprinkle over the cut surfaces with a light layer of an equal mixture of saltpetre and dry antiseptic or some other boron preservative, and on top of this put a *thick* layer of salt. The process of curing begins immediately, and consists in a slight decomposition of the meat, which imparts an agreeable flavour to it. The decomposition is arrested by the preservative that is used, and in this way the meat is rendered proof against immediate decay. In the curing process, however, a solution of salt and other preservatives displaces a certain proportion of the meat juices, and in that way really destroys the value of the meat This displacement varies in different kinds of meat, and in the case of pork amounts to 40 per cent of the meat juices present Cured meat, however, is an article which is always in demand, and there does not seem any way, in the present state of our knowledge, of preventing this heavy loss

The pickle which runs away from the meat consists of a solution of salt in the meat juices, and is sometimes used, after being boiled, for curing meat by the wet process. It is, however, liable to very quick decomposition. The dry curing may be continued for two or three weeks, that is to say, until the salt has permeated into the tissues of the meat throughout.

Bacon or other meats which are to be kept for a period running into months require to be more heavily salted, that is to say, they must be left in dry salt from three to four weeks according to size, and until they are thoroughly saturated with the curing solution.

When the process is judged to be complete, the meat may be taken out and washed in a solution consisting of cold water, to which a little dry antiseptic (1 per cent) has been added. The meat may then be hung up in a kitchen or any other dry place to dry, and will then be ready for use.

The curing of meat by the wet process consists in utilizing the pickle described above, first of all, by injecting it into the tissues of the meat, and secondly by immersing the meat in it. The process consists in first of all pumping the meat all over with the curing pickle, and then throwing the meat into the pickling tanks or tubs, which are partly filled with the cool pickle, testing about 100° as already indicated The meat is weighted down in this pickle by means of boards upon which heavy stones are laid, so as to keep the meat always under the level of the surface

The same remarks apply to the length of time for curing in the wet way as in the dry way, and if mild-cured meat is wanted, fourteen days is looked upon as being the correct period for cure. If, however, the meat or pork is required for keeping a lengthy period, it must be left in the curing pickle for at least double the period of immersion required in the case of mild-cured meat When the meat is withdrawn it is wiped dry and hung up as before, and when fairly dry it will be ready for use.

Rounds of beef, such as are sold as corned beef, are produced by adding to one of the tubs which contains the standard pickle some black peppercorns and coriander seeds Large rounds of beef, however, require a considerable amount of curing, which must be left as a matter of judgment to the operator

A very good rule to follow in the curing of all meats is to keep the meat in pickle or in dry salt for one clear day for every pound weight of meat concerned, this will give a mild-cured meat If, however, the meat has to be kept a long time, it should be cured for two days for every pound of meat

The smoking of beef is carried out as follows The meats are usually dried by hanging them up in a dry room or kitchen first, until the excess of moisture is evaporated, after that they may be placed in the smoke stove, where they are subjected to smoke arising from smouldering hardwood sawdust Oak or beech sawdust is best for the smoke process, and sawdust such as that from pitch-pine wood must be carefully avoided, owing to the excess of resin which is present. Generally speaking, two to three days are necessary for imparting the smoky flavour to meat.

There are several variations of the process of preserving, such as the preparing of pressed or braised beef or briskets, which, after being boned and cured, are cooked, and pressed in a brisket press. The meat is covered with a glaze or jelly. This is allowed to harden, and the meat is then sliced and ready for consumption.

Corned beef is produced in the same way as other cured meats; that is to say, it is cured in a recognized pickle. It is, however, desirable, if the meat is intended for canning, that it should be cured for a prolonged period, after which it is cooked until it is soft in the texture, and is then packed in 1, 2, 4, 6, and 14 lb. tins, which are hermetically sealed, and which are kept at a temperature of about 240° F. for about forty minutes, so as to destroy any spores which may be present. See also arts. CHILLED BEEF, COLD STORAGE, FROZEN BEEF, CARCASS, &c [L. M. D.]

Beef, Chemistry of.—The table on p. 101 represents the most recent analyses of beef and veal, as well as the most detailed accounts of the different substances.

Beef, Statistics of.—The production and consumption of beef within the United Kingdom have been often the subject of statistical investigation. Before 1866 the extent of our herds was a matter of very uncertain estimate. Since that date the numbers of the cattle maintained on the farms of this country have been ascertained annually From that figure the native production of beef has been deduced by several enquiries The imports of beef from abroad are the subject of exact yearly account, and estimating the weight of the supply which reaches our shores 'on the hoof' or in the shape of live cattle, the total weight available for the consumption of our population is ascertainable. By far the most exhaustive enquiry into these matters was that conducted into the question of meat supply generally by the Royal Statistical Society in 1903–4 Its conclusions may be thus accepted as representing approximately the facts of the case. More than a million tons annually of beef and veal was then suggested as consumed yearly by our distinctively beef-eating population, less than two-thirds of the whole being produced at home, and more than one-third imported annually. Per head of the inhabitants of all ages and grades, on the average of the five years 1899–1903, these estimates supplied some 57 lb per annum, whereof 36 lb was native produce and 21 lb raised abroad At the present day there has been some slight extension of our herds of beef cattle, from 11,361,000 head on the average of the years above mentioned to 11,628,000 head in 1907. This means that the home supply may be about 2⅓ per cent greater The population has, however, grown still faster, reaching 44,100,000 persons in 1907, or 6⅔ per cent above the older level, while the imported beef has increased more rapidly still, and in place of the 360,000 tons of beef landed alive or dead, quoted in the committee's report, we have received 454,000 tons in the year 1907. This is an increase of 26 per cent It follows that the people of the United Kingdom, notwithstanding their growth in number, have to-day a rather larger ration of beef than before, or 58 lb per head, of which more than 23 lb a head is supplied from other lands, and roughly about 35 lb furnished from our home stock.

The changes which have taken place in our consumption of beef, and in the character and sources of our seaborne supplies, are worth attention. In the earlier days of our agricultural statistics, 1867–9, with a population of some 30,700,000, and a home stock of 9,000,000 cattle, the beef imports were only 55,000 tons, whereof nearly four-fifths, or 78 per cent, came as live

	WATER	DRY SUBSTANCE			PROTEID						ORGANIC EXTRACTIVES			FAT.
	%	Soluble	In-soluble	Total	Soluble				In-soluble	Total	Nitrogenous	Non-nitrogenous	Total %	%
					Coagulable	Albumose	Peptones	Total %						
1 Beef, round, raw	74·89	7·26	18·00	25·26	2·62	0·23	0·08	2·93	15·67	18·60	1·34	2·00	3·34	2·24
2 Beef, round, raw	75·61	6·21	18·19	24·40	2·08	0·23	0·10	2·41	15·97	18·38	1·26	1·54	2·80	2·14
3 Veal, breast, raw	63·34	4·65	31·86	36·51	1·55	0·18	0·06	1·79	15·10	16·89	0·78	1·42	2·20	16·52
4. Veal leg, raw	73·40	5·81	21·50	27·31	1·52	0·22	0·10	1·84	16·28	18·12	1·21	1·87	3·08	5·02
5 Beef, ribs, roast	44·78	2·76	52·32	55·08	0·36	0·14	0·02	0·52	15·30	15·82	0·77	0·82	1·59	36·84
6 Beef, ribs, roast	49·73	3·04	47·63	50·67	0·26	0·12	—	0·38	19·65	20·03	0·91	1·04	1·95	27·79
7 Beef, round pot-roast	57·57	3·24	39·61	42·85	—	0·43	0·03	0·46	35·14	35·60	1·01	1·09	2·10	4·20
8 Beef, round, pot-roast	56·92	4·24	40·11	44·35	—	0·32	0·05	0·37	34·32	34·69	1·31	1·53	2·84	5·58
9 Beef, round, boiled	55·96	2·92	41·69	44·61	—	0·39	0·02	0·41	33·01	33·42	0·83	1·06	1·89	8·47
10 Beef, round, boiled	61·70	1·76	37·24	39·00	—	0·19	0·14	0·33	33·45	33·78	0·47	0·54	1·01	3·65

	ASH			NITROGEN							PHOSPHORUS				
	Soluble	In-soluble	Total	Soluble			In-soluble	Total	Ratio – Proteid to Non-proteid		Soluble			In-soluble	Total %
				Proteid	Non proteid	Total			In Water Extracts	In Meat	Inorganic	Organic	Total		
1. Beef, round, raw	0·99	0·09	1·08	0·469	0·431	0·900	2·506	3·406	1 : 1·09	1 : 7·91	0·153	0·104	0·257	0·088	0·345
2. Beef round, raw	1·00	0·08	1·08	0·386	0·402	0·788	2·556	3·344	0·96	8·32	0·090	0·097	0·187	0·035	0·222
3 Veal, breast, raw	0·66	0·24	0·90	0·286	0·251	0·537	2·416	2·953	1·14	11·76	0·075	0·037	0·112	0·087	0·199
4 Veal, leg, raw	0·89	0·20	1·09	0·292	0·387	0·679	2·605	3·284	0·75	8·49	0·118	0·039	0·157	0·064	0·221
5 Beef, ribs, roast	0·65	0·18	0·83	0·082	0·248	0·330	2·449	2·779	0·33	11·21	0·095	0·023	0·118	0·030	0·148
6. Beef, ribs, roast	0·71	0·19	0·90	0·060	0·292	0·352	3·144	3·496	0·21	11·97	0·104	0·044	0·148	0·042	0·190
7 Beef, round, pot-roast	0·68	0·27	0·95	0·073	0·322	0·395	5·623	6·018	0·23	18·70	0·112	0·049	0·161	0·066	0·227
8 Beef, round, pot-roast	1·03	0·21	1·24	0·059	0·419	0·478	5·491	5·969	0·14	14·24	0·122	0·059	0·181	0·083	0·264
9 Beef, round, boiled	0·62	0·21	0·83	0·039	0·266	0·305	5·306	5·611	0·15	21·10	0·085	0·041	0·126	0·087	0·213
10 Beef, round, boiled	0·42	0·14	0·56	0·053	0·151	0·204	5·351	5·555	0·35	36·79	—	—	0·068	0·094	0·162

[J. K.]

animals. To-day, with some 13,400,000 more mouths to fill, our larger herds of over 11,600,000 head require to be supplemented by imports more than eight times as large, but only one-third of this quantity now comes alive. Over 300,000 tons of the whole 454,000 tons of beef reach us in the chilled, frozen, or preserved form, which has proved the most economical mode of trade, and that fraught with least danger to our own herds. Again, it is well to observe that the source of our seaborne supplies has entirely altered. In 1869 our whole importation of live cattle came from Europe; now the United States, and in a minor degree Canada, alone maintain this trade, for the small quota we receive from the Channel Islands is not primarily for beef. Although there has been some reduction lately, nearly three-fourths of the animals reaching us 'on the hoof' still come from the United States. The transatlantic predominance is very nearly as pronounced in the case of beef slaughtered on the other side, although here South America has challenged, and in the last two years has even beaten, North America as a source of supply. Argentina alone contributed nearly 17 per cent of the frozen or chilled supplies which reached us in 1906, and about 45 per cent in 1907, while the United States sent 46 per cent in 1906 and over 44 per cent in 1907. The Australasian supply of beef, mainly from New Zealand, was relatively small, but it is a distinctly increasing trade, estimated at over 5 per cent in 1906, and not far short of 9 per cent in 1907.

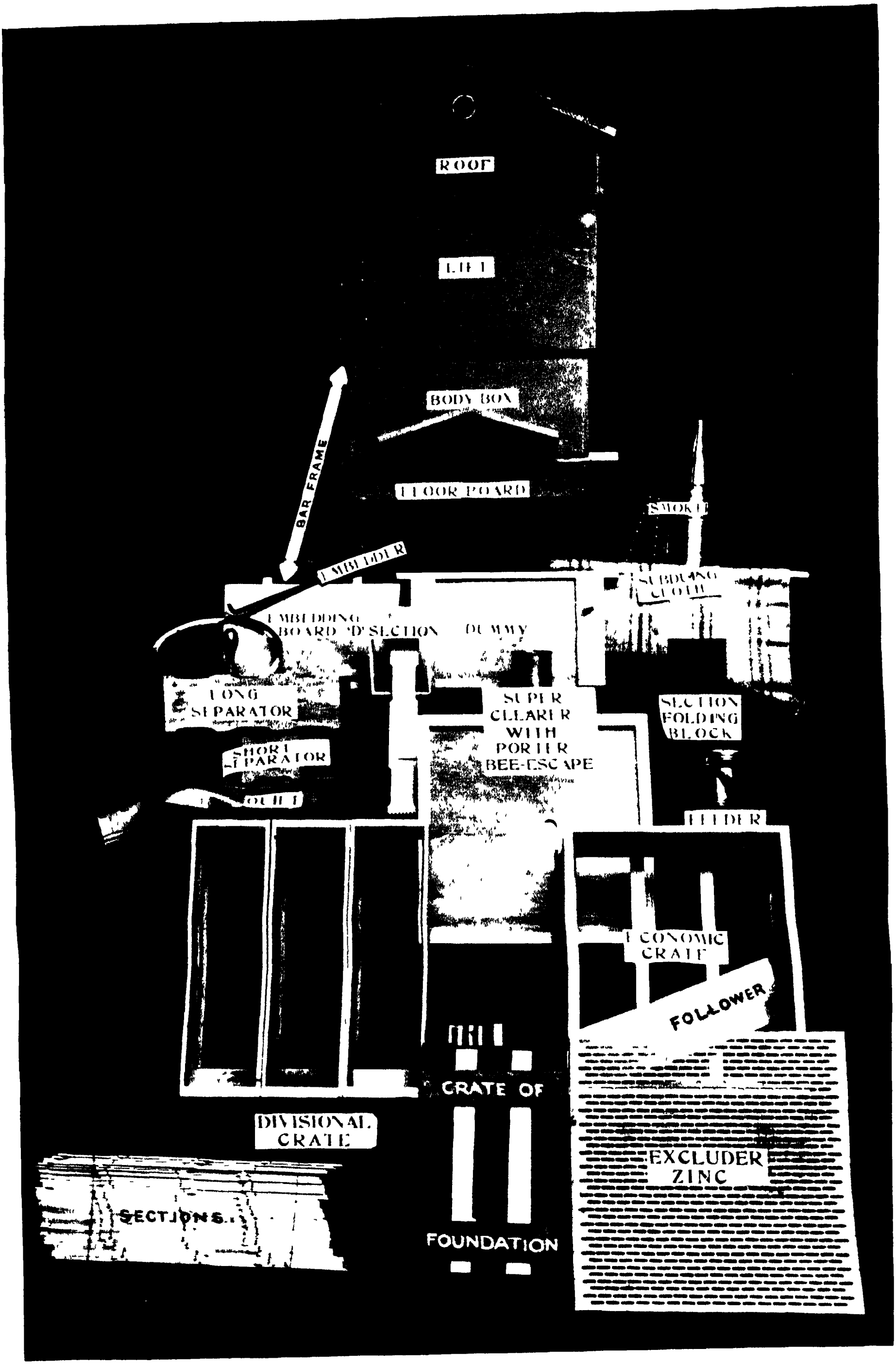
With these great changes in our sources of supply, it is interesting to observe the course of prices of beef in this country. No general tables giving the average values at various markets are here available, as in the case of the corn returns from numerous towns in England and Wales, from which the official average prices of grain are computed, although of late years a new series of records have been compiled by the reporters of the Board of Agriculture. These may enable our successors to have eventually a continuous and comparative quotation. In default of earlier data the returns from time to time laid before Parliament quote prices at the Metropolitan market of London, which can be carried back to 1820, as a range of values up to 1840, and in four separate grades of quality thereafter up to 1885. A more or less regular series of quotations from that date appear in the Annual Returns of the Board of Agriculture. Consulting these authorities, the earliest quotation of 3*s.* 4*d.* to 4*s.* 8*d.* per 8-lb. stone, in London in 1820, seems to have declined to 2*s.* to 3*s.* only in 1822, rising again to 4*s.* to 5*s.* 4*d.* in 1827. Between 1828 and 1839 the minimum limit recorded seems to have been 3*s.* 2*d.*, while the maximum limit never exceeded 4*s.* 8*d.* for 'superior beasts'. A period of lower values followed, inferior grades of beef standing only five times above 3*s.*, and once receding to 2*s.* 5¼*d.* in 1852, while the highest class of meat quoted (Scots) once reached 4*s.* 7½*d.* and once 4*s.* 8*d.* per lb., but usually ranged lower. By 1871 the lower-grade prices had recovered to 3*s.* 11½*d.*, and the upper level reached 5*s.* 8½*d.*

With 1873, in harmony with the general rise of prices, those of beef were carried to a figure just beyond 6*s.* per 8 lb. at the upper end of the scale, and over 4*s.* in lower grades. Between that period and 1885 the lower quotations never went below that figure, but the higher limit of values is shown as declining from 6*s.* to 5*s.* 9*d.* Thereafter to the end of the century a visible decline was recorded, a price of no more than 2*s.* 4*d.* per 8 lb. appearing frequently at this market for beef of inferior quality, and the quinquennial maxima of the Board of Agriculture quotations averaging only 4*s.* 9*d.* for 1886–90, 4*s.* 8*d.* over 1891–5, and 4*s.* 6*d.* over 1896–1900. The next five years exhibited a recovery, the quinquennial average for 1901–5 appearing as 2*s.* 9*d.* in the inferior class of beef and 4*s.* 8*d.* in the higher grades, values which were about those current in 1906.

The course of prices to consumers of beef can hardly be taken to be shown by the above records of the values of the produce of British stock, although in the lower grades the competition of the recently augmented imports is very clear. Until the last quarter of the nineteenth century imports of foreign meat were not perhaps appreciable in volume, but thereafter the cheapening which followed their growth is conclusively shown by the separate tables of the values of foreign meat given from the Customs records. Every imported hundredweight of foreign beef in the five years 1876–80 showed a value of 53*s.* 4*d.* This quotation fell by 1894 to 40*s.* per cwt. From 1896 to the close of the century the average was 38*s.* 6*d.*, while in 1904 only 37*s.* 1*d.* was recorded, and by 1906 this had fallen to 35*s.* 5*d.* If calculated in 8-lb. stones, like the London quotations for native beef, these values would represent a fall in this class of beef from 3*s.* 10*d.* to 2*s.* 6*d.* in thirty years. [P. G. C.]

Beehives.—It is of the greatest importance that in beginning beekeeping a proper hive should be selected. Bees will build combs and store honey and rear brood in almost any kind of hive or box. Their original habitat was probably in the trunk of a hollowed-out tree, or in holes of rocks, with the combs depending from the roof of the cavity, thus avoiding the damp that might gather at the bottom from in-driven rain or mist or fog. Hence the almost inveterate habit of bees running upwards, and their great aversion to 'climb down'. Where no other place offers, they will enter a chink in a wall, or a hole in a roof, and make a hive of the dry interior. Except for experiments or for a curiosity, the standard hive of the British Bee-keepers' Association, the bar-frame hive, is to be recommended. The central idea of this hive is the movable bar-frame holding each comb, by means of which the contents and condition of the hive are at all times accessible to inspection. In this way alone is it possible to manage bees for the highest honey production, and to ensure the health and prosperity of each colony. This is so obvious now, and for such a variety of reasons, that it seems uncalled-for to enlarge further on the subject.

Assuming that the bar-frame is the best type of hive for ordinary purposes, the next point is



A BAR-FRAME HIVE AND APPLIANCES USED THEREWITH

(From 'Instruction in Bee Keeping', Irish Department of Agriculture. By permission)

get an up-to-date hive of this sort, for great ances have been made since the first intro- tion of this hive by Huber and Langstroth. ese improvements had two objects in view: the making of a hive suitable to the instincts d proclivities of the honey bee; (2) the de- ability of procuring the largest surplus of he comb honey for use and sale. The best ves now in the market leave little to be de- ed in these respects. It is hardly necessary describe the sizes and distribution of the mponent parts of a good bar-frame hive. Few uld think now of making their own hives, cept professional apiarians and appliance- akers, for the work has been brought to great rfection and standardized by the makers, so at hives can be best and most cheaply ob- med from them. If any handy man should, wever, wish to make hives, it is better to ocure one of the best in the market as a ttern, and copy from it, than to attempt to uild a hive from descriptions and diagrams. he following are a few of the leading hives in he market, each of them having points of advan- ge of its own: the Cowan hive, the W.B.C. hive, he Neighbour, the Abbot, the Lee, the Howard, he Baldwin, the Meadows, the Redshaw, and thers too numerous to mention. There are also number of American 'lick-creation' hives of great merit. It will be sufficient here to give few practical suggestions in the selection or making of a hive. (1) All hives and appliances should be of the standard size of the British Beekeepers' Association, thus facilitating interchange in the apiary or between neighbours. (2) All outside woodwork of the hives should be of sound yellow pine, as free from knots as possible, and dovetailed or securely nailed at all the joints. Hives should be bought unpainted, and examined carefully before painting, a bit of putty or a lick of paint can be made to hide a multitude of sins. (3) All hives should be on the storifying principle—that is, it should be possible to build up three or four stories on the body-box by means of lifts (boxes for frames or sections) with plinths, the surplus honey being stored in these lifts, either in shallow frames or in crates of sections (*i.e.* honey boxes). (4) It is desirable that, as far as possible, the different parts of the hive should be separable, in order to facilitate cleaning, &c. (5) Every hive should have a good-sized alighting-board, reaching almost to the ground, with a roof porch above it; entrances capable of being enlarged and contracted by shutters, and a roof substantial yet capable of being easily lifted off and on. (6) The interior of the hive must be thoroughly wind and water tight. Bees cannot stand damp. It should not be too high above the ground. A bar frame may be made ready for a swarm of bees as follows. The frames are filled with comb foundation (strong sheets of wax with the imprint of the base of bee cells upon both sides of them), and two division boards to put one at each end of the row of waxed frames to keep all comfortable and in place. It will be noticed that the wooden dummy (division board) next the entrance has a slot to allow the bees to pass under it into the hive. On the top of the frames, which are properly spaced by metal ends or wooden lugs, is placed one thickness of ticking or American cloth, and above that two or three pieces of old flannel or drugget to keep warm and cosy. These coverings are termed bee quilts. A good 'smoker' is then got ready, filled with a little brown paper or dried cotton rag, and set alight. The bee veil is then adjusted, and the hands may be rubbed with apifuge, but it is unnecessary to put on gloves. All doors and entrances should be wide open. The operator may then proceed to hive the bees, as described in next article. Next day the entrances may be contracted, and then allowed to stand for eight or ten days. If the weather be good and honey coming in freely, they will then have drawn out the wax foundation into regular combs, and in a great measure have filled them with eggs, brood, honey, and pollen. It may now be required to put on supers, that is chambers to gather surplus honey, the body-box and frames being severely let alone for brood raising, storing bee food, &c. It is well to have a lift that neatly telescopes over the body box when the lid is removed. This lift may contain either a crate of shallow frames or of 1 lb sections fitted with super foundation (that is, very thin wax sheets stamped, as before explained). The comb foundation and the super foundation are fastened into the frames and sections in various ways—sometimes by a little melted wax or glue into a groove made for the purpose; at other times by a split in the frame or section, into which the sheets of wax are inserted, and then the sides of the split are closely pressed and held together by a tack or a metal end. For security in travelling or in very warm weather, brood combs may be wire. It is of great importance that the sheets hang even and at equal distances from each other. The various hive-makers already mentioned, and others, have invented special shallow frames and section crates, each of which has a particular feature of its own, and the young beekeeper is advised to see and carefully examine these models. All being ready, the bees are subdued and the quilts removed, as explained in next article. The combs should be well drawn out, filled up, and sealed, and particular notice should be taken that there are sealed honey cells on the top of the bar-frames. This being so, a queen and drone excluder is put on (a contrivance to keep out the last-mentioned bees but allow the free passage of worker bees to the supers above) over the top of the bar-frames. The crate or super with shallow frames or 1-lb sections is then placed evenly on top of frames. The quilts that were formerly over the frames in the body-box are replaced on the top of the super. Round the junction of the body-box and super, waste cloth or paper is carefully packed, the cover is replaced, and the hive is then left alone for another week or so. It may then be seen how they are filling the super, and if more room is necessary another super is placed over the frames, and the filled or half-filled super put on the top of it to seal and finish off. This may be repeated as often as necessary in a good season, great care being taken by packing to keep the supers warm, else the bees will not work in them, but mass themselves in the comfortable body-box. Bees as a rule readily enter crates of shallow frames, but they only work well in sections under high pressure. It is therefore sometimes necessary to contract the size of the brood nest below by taking out all frames in which there is no brood, brushing off the bees in front of the hive, and bringing the division boards closer together. This forces them up into the sections above, but may lead to swarming unless proper precautions are taken. Another way to lure them into the section crate is to place a few filled sections in it along with the empty ones. There are many other little devices for honey production, to be learned only by intelligent experience. Whenever crates are well filled and sealed, their contents should be removed to the honey room, at some distance, as it is sure to give rise to fighting and robbing, if loose honey is left anywhere within reach of the bees. There is a method of getting large quantities of run honey by means of the extractor. When there is a great flow, the sealed combs (sometimes the unsealed ones too) are taken out of the hives—the surface sealing of both sides pared off with an uncapping knife, the combs fixed firmly in the extractor and whirled round at a great speed, whereby the honey (by the centrifugal motion) is thrown out of the combs, collected at the bottom of the extractor, and run off by a tap there. The combs can be returned at nightfall to be refilled. It is not advisable to attempt to learn this by mere book description, or failure and loss will be the result. It requires a knowledge of the ripeness of honey before extraction, of how to mature unripe honey after extraction, and of how to separate the watery honey from the thick, and filter out all impurities. These different points can only be truly learned at the hands of an expert, in the apiary itself. The same remark applies to the extraction of heather and other very thick honeys by means of a press or strainer. (For the removing of bees from filled crates see *Apifuge*.) For the despatch of skeps, boxes, and bar-frame hives containing live bees in swarms or stocks, by van, railway, or steamer, to a purchaser or to the heather, some experienced hand should be consulted. Many tragedies and disasters, some of them fatal both to man and beast, have occurred through the escape of bees or overturning of beehives in transit from one place to another. Tough or wired combs and plenty of ventilation are a *sine qua non* to the safe movement of stocks of bees.

[R. M'C.]

Bees and Beekeeping. The study of bees in general and the management of the hive bee are full of the most absorbing interest. The hive bee belongs to a race of insects of which the wasp and the humble bee are members, and it may be represent different stages of progress and civilization. The wasp, beautiful and nimble as he is, represents the barbarian or solitary stage—his hand against every man and every man's hand against him; who has far more delight in plundering than in working; who is not particular about what he eats, partaking alike with gusto the sweetest honey and the most putrid animal matter, and who is so hardy that he can work in all weathers, and so tough that it takes a strong blow to stun him. The humble bee, big, honest, droning fellow, represents the clan stage, with its chieftains, its small families, and its headquarters in fast places. The hive bee represents up-to-date twentieth-century civilization, with its teeming populations, its centralization of authority, its division of labour, and its perfect example of the utilitarian system of morals. The hive bee belongs to the family of insects termed Apidæ, and has for brothers the mason bee, the carpenter bee, and others. Its own technical name is *Apis mellifica* or honey bee. There are a great many varieties of the honey bee, such as the British black bee, the Carniolan lighter-banded bee, the yellow Ligurian bee, the Syrian, Palestinian, Tunisian, &c. In every hive of bees in a healthy and normal condition during the honey season there are three kinds of bees, queens, drones, and workers improperly called neuters. The queen bee is the mother of the hive, on her presence and fertility hangs the whole welfare of the community. It is small wonder, then, that she is everywhere received with the highest respect, waited on assiduously, fed constantly with the best, and cleaned and combed as befits her position. Her sole function is to lay eggs, and when she is in good fettle she can do so at the rate of between 2000 and 3000 in twenty-four hours. She has a graceful tapering body, short wings, a varying brownish colour, and is provided with a sting, which she only employs in battle with a rival queen. Her average age is two to three years. The drones are the males of the hive, brought into existence by the queen in the springtime, when maiden princesses, called virgin queens, have to be mated, and at the end of the season, when their services are no longer required, they are ruthlessly slaughtered or expelled from the hive by the workers. Should a hive be queenless or have an unfertile queen it will retain its drones. Drones are said also to help to keep up the heat of the hive, but their presence in late autumn or early winter is a very bad sign in a hive. They are very large, have strong wings, and make a loud, humming noise in flight. They have no stings and therefore may be handled with impunity by anyone.

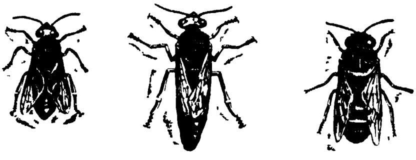


Fig. 1.—The Honey Bee (*Apis mellifica*)[1]

The workers are the labouring millions of the hive. They are really unsexed females, who by being bred in cramped-up cells and fed on more meagre fare have not the organs of

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[1] Figs. 1 and 2 are taken by permission from Bees and Beekeeping, by Cheshire.

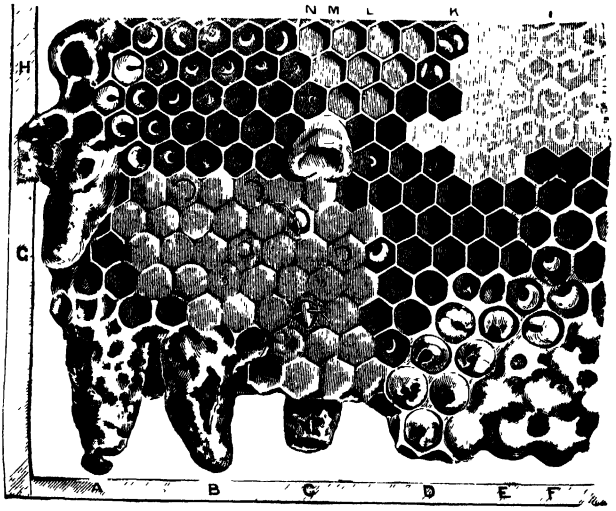


Fig 2 --Honeycomb, natural size

A, Queen cell, from wh[illegible] queen has hatched, showing lid open; B, Queen cell torn open at [illegible]ide, C, Quee[illegible] cell cut down by bees, D, Drone grub, E, Drone cell, partly sealed F, Drone c[illegible]ls sealed, G, Queen cell sealed, H, Old queen cell, O, Eggs and la[illegible]arious stages, N, Transition cells, M, Aborted queen cell on face of comb, [illegible]e cells, open, K, Fresh pollen masses, I, Sealed honey cells
In the left c[illegible] the comb are shown sealed worker cells, with some workers biting the way [illegible] In the right hand upper corner are shown sealed honey cells.

reproduction developed. The same egg when newly laid and for a little after can be made into a queen or a worker at the will of the bees. The workers are smaller than either queens or drones, and have curved stings. If they send their stings home, they lose them, and die from the effects of the rupture Their average age in summer is about six weeks, but late autumn young bees live on till the following spring. In the absence of a fertile queen, sometimes one of the workers develops the power of egg-laying, scattering batches of eggs here and there, instead of the orderly and methodical laying of a queen Such a fertile worker is a pest, and should be got rid of as soon as possible; her eggs only produce drones. The various organs and functions of bees, of course, vary in each case, according to the requirements of queen, drone, and worker The worker may be briefly described as being the typical bee of the community, the others being wonderfully modified to suit their office. Each bee has three pairs of legs and two pairs of wings The legs really furnish the bee with its working tools; the first pair have each a comb and brush, by which they can clean their antennæ or little horns, instruments of touch of the most delicate kind, the second pair have a spike or pair of pincers to lift out pollen, or flower seed, from the hind legs, and the third pair have a sweeping brush and basket, in which to store pollen and propolis (resinous gum) and carry them home At the extremity of each foot there are hooked claws by which the bee can hang comfortably from any object or in cluster from other bee, and there is a beautiful pad also by which it can walk head downwards along the smoothest of surfaces The wings are powerful and rapid in flight, especially in the case of the drone who has to pursue and capture his bride in mid air On the head are the antennæ, at the base of which are supposed to be the organs of hearing, there are also marvellous compound eyes consisting of hundreds of facets The jaws or mandibles are strong and used as offensive weapons—biting and sawing, and in the kneading and making of wax into honeycomb The tongue or proboscis is long and tubular, for tapping flowers that are deep and bell-shaped, and conveying the nectar to the mouth and honey stomach, it can be folded up in small compass between the jaws when not in use. The sting consists of a pair of sharp-pointed hard sheaths, inside of which two lancets work up and down alternately while poison from a sac is pumped into the wound The curved sting holds fast in any fleshy substance, and tears away from the body, causing death. Stings should always be removed by digging them out from the point with a knife needle, and not by attempting to seize the end of them, which simply presses all the poison into the wound. One of the principal ingredients in the poison is formic acid; and bee poison is said to have been tried with good effect as a remedy for rheumatism. The genesis of the hive bee, like that of many other insects, is a series of marvels, a gallery of miracles in itself Bees carry on all their honey-gathering and brood-producing in slabs of cellular wax called honeycombs The slabs are about ⅞ in thick, and are penetrated on both sides into the midrib (or partition) by rows of hexagonal cells packed as closely as security will permit Worker cells for brood and honey are about ⅕ in across, drone cells about ¼ in. There are 18 drone and 28 worker cells to the square inch approximately The cells are mostly regular but vary occasionally, particularly those attaching combs to their support, and those joining one variety of cell to another. Queen cells are totally different from the others, resembling elongated acorns with the point hanging downwards, and are about 1 in deep and ⅓ in across Cells containing honey are sealed with wax, and for a time a tiny aperture is left in the cover, the sealings of brood cells are composed of wax and pollen—in fact the baby bee at birth eats out its way into the world. Queen cells are a mixture of wax and pollen, very porous, and after the birth of the virgin queen are taken down and used for other purposes See art Wax

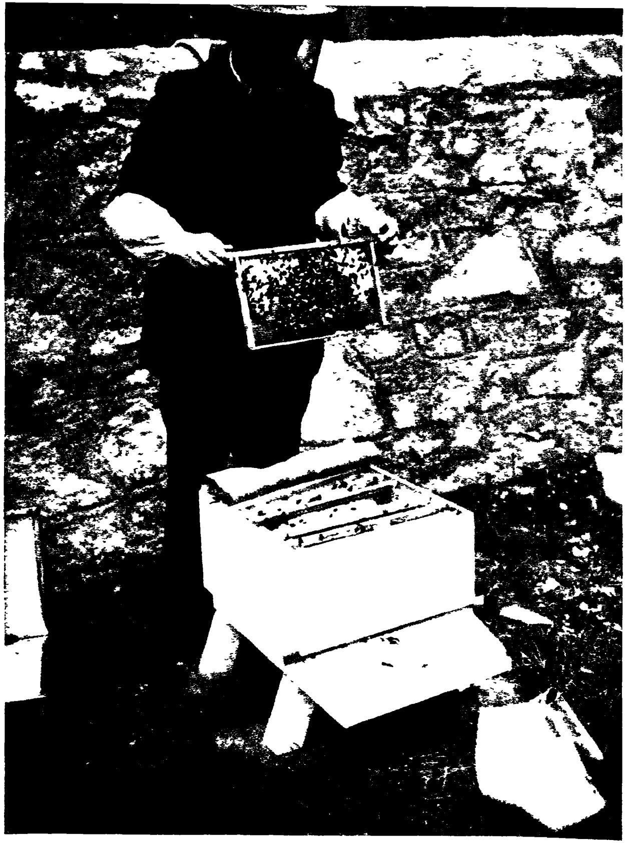
And now let us glance at the birth of a hive bee. Notice the queen and her attendants moving along the combs; she stops at one, inserts her head into it, to make sure it is clean and ready, and then turning round, by means of her ovipositor deposits an egg on the bottom of the cell, a very minute bluish-white oblong cylinder. The egg is attached to the cell by a gluey, mucous substance and is about $\frac{1}{12}$ in. long During the next three days the egg changes its position in the cell from time to time, and finally a little white grub is born from it. The worker bees then feed it with bee pap or chyle food, a digested and highly nourishing jelly composed of pollen and honey prepared in the stomach of the workers In this it literally floats, sucking by the mouth and absorbing by the skin, while the most wonderful changes take place in moulting and renewing its skin Later on weaning takes place, plainer food is given, and on the ninth day it is sealed up, spins a cocoon, becomes a nymph, and emerges a perfect insect; in queens on the sixteenth, in drones on the twenty-fifth, and in workers on the twenty-second day after the egg is laid The young workers are employed for about a fortnight as nurses and housemaids, and then hie them to the fields to enjoy life and to collect stores Drones begin their flights about a fortnight after birth, and virgin queens leave for the marriage trip in from five to seven days after birth, and except to head a swarm never leave it again Previous to marriage, queens are of no account among the bees, after, they are all in all to them

The swarming of bees is one of the most interesting phenomena of insect life, and once seen can never be forgotten Towards the end of May or beginning of June, in a favourable season, swarms may be expected, the earlier the better, as—

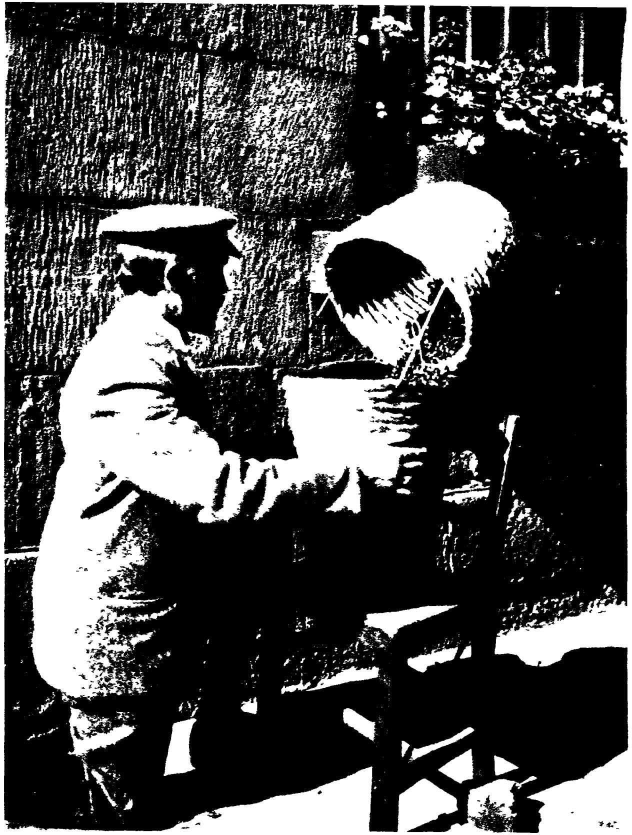
> 'A swarm in May is worth a load of hay;
> A swarm in June is worth a silver spoon,
> But a swarm in July is not worth a fly'.

The reason is that early colonies are almost certain to collect surplus stores for the beekeeper, whereas late ones cannot even lay up sufficient food for themselves, but require to be fed The usual signs of swarming are the crowded state of the hive, and in close warm weather the bees will lie out in large numbers on and about the alighting-board First or top swarms are headed by the old queen, and will not come out except in favourable circumstances Between 10 a m and 2 p m on a sunny calm morning is a favourite time, but bees do nothing invariably; when you wait for them they won't come; but on Sunday morning about church time they often suddenly emerge two or three swarms from different hives. You may watch for hours and nothing happens; go away for five minutes and they are off. Before emerging, outdoor work almost ceases, crowds gather about the door, rushing, humming, and raising their wings. All of a sudden, as if pursued by fire and sword, they come rushing out of the hive in a body and rise into the air with a loud, excited, humming sound So great is the outflow that they fall from the floorboard into the air or on to the ground like a volume of water, till it seems as if not a bee will be left behind. Now is the time to keep the eyes open and the ears wide. The air is full of circling humming bees, while the drones literally roar with their deeper basso voices. By and by a wave of the cloud of insects will be seen making towards a tree or bush; the queen has alighted, and round her precious person in a few minutes a cluster of bees will form themselves, varying in size from a child's to an adult's head, and somewhat resembling a monstrous pear hanging from the point of a branch or twig Give them five to ten minutes to settle, which may be hastened by gently spraying a little water over them *Now secure them as quickly as possible.* When they cluster in difficult places you had better get the advice or aid of some expert in your neighbourhood Ordinary common sense will suggest the way best suited for getting at them. The *modus operandi* is extremely simple Take a good-sized common straw hive or skep and its floorboard, and bring them to the place where the swarm is hanging Turn the skep mouth upwards, and hold it in the one hand exactly below the swarm With the other hand grasp firmly the branch or twig from which the cluster depends, and give it a sharp, quick shake. The cluster will fall *en masse* into the skep, a few *flying into the air.* Now *lift the* floorboard and push it gently and laterally across the open mouth of the skep so as not to crush the bees, slowly turn skep and board together upside down, and set them on the ground beneath the tree or bush, propping up the skep on the floorboard, so as to allow stragglers to enter, and also to keep the skep cool inside. In a few minutes queen and swarm will be safe in the roof of the skep; odd fliers may be disregarded, as they will afterwards rejoin the parent hive, so *without any delay* carry the skep on its board to the spot where the new colony is to be located, set it down, protect from the sun by covering with a white sheet, and spray with water if they show signs of restlessness. Be sure to leave plenty of room for bees to go in and out. They will begin at once to mark their new abode, hence the necessity of setting the skep where the bar-frame hive is to stand, for if left for even an hour or two beneath the swarming spot, they will begin to work, take their bearings, and if removed later come back again and again to it It may sometimes be easier either to cut away the branch, holding it firmly to prevent shaking, and then lay the branch with its swarm in front of an empty skep, when the bees will soon run in; or to place an empty hive securely over the swarm, and by a little smoke drive the bees up into it The one point is to get the swarm as quickly hived as possible in whatever way seems best in the circumstances, for should they rise into the air again they will most probably be lost. The law of straying swarms is that they belong to the owner as long as he can keep them in sight; when lost

BEES AND BEE-KEEPING - I



OPERATOR WEARING VEIL AND SLEEVELETS EXAMINING HIVE



DRIVING BEES FROM A SKEP

(From 'Instruction in Bee-keeping.' By permission)

ew they become the property of the finder.
ringing of bells and tanging of pots
paus is of no value whatever in bring-
down errant swarms. Very fine sand
vn up at intervals, or better, a little water
ted among them like a shower, may arrest
flight; but there is only one sovereign
which is, by expeditious hiving and by
ul attention never let them away till they
in their home. Bees before swarming
ally gorge themselves with honey, and are
lly quite docile, but stocks whose temper
known, and particularly crosses, sometimes
and sting furiously; so it is safe to wear a
veil, but gloves are troublesome. A stock,
rong to begin with, generally throws off a
ıd swarm or cast about eight to ten days
the first. If you listen in about a week
the top swarm comes off, close to the hive,
ally in the quiet of the evening, you are
y to hear amid the general hum a sound
hrill piping like peep, peep, peep; this is
followed by a duller quack, quack, quack
first cry is that of the new queen, who thus
s vent to her anger because the bees are
enting her from destroying the remaining
n cells, the second is the cry of defiance
young unborn princess from the royal cell
en this is heard, swarming is near at hand,
may take place at any hour of the day, and
ny sort of weather. The young queens are
ıty and inexperienced, and do all sorts of
gs, sometimes leading the swarm to some
cessible place or flying away with it at once
out first settling, to nobody knows where
ly second swarms may be made into good
ks, or they may be returned to the parent
k after sitting beside it for twenty-four
rs, and then removing the queen from them
other casts are useless and hurtful to the
k.

he best plan is to hive the swarm into its
manent home at once and allow the bees to
le and begin work. Have your bar-frame
e ready (see art. BEEHIVES) with comb foun-
ion, quilts, and roof ready to put on. Bring
straw hive or skep containing the swarm
e to it, with the entrance looking the same
, and set it down gently. Now get a piece
smooth sloping wood and place it against the
board, so as to make one inclined plane
m the frame hive entrance to the ground.
ead over this a clean white towel leading
m the foot to the entrance. Now lift the
p full of bees cautiously from its floorboard,
d it exactly over the middle of the towel,
l give a strong sharp jerk. The bees will
'like a bushel of peas' on to the cloth, and
er a moment's wonder what it is all about,
merrily up into the bar-frame hive. Watch
queen running in, as all is right after that.
ep the entrance wide, and raise a corner of
quilt for ventilation. At night replace the
sed quilt and put on the roof quietly; the
w stock is established. There are other ways
hiving into a bar-frame hive, but none of
m can be recommended.

There are various methods of preventing
arming, so as to secure continuous storing of honey by strong stocks of bees; for swarming always interrupts honey storing besides greatly weakening the parent stock The principal features of these methods are the giving of boxes of empty frames of foundation below the brood hive; placing plenty of shallow super frames above it; removing brood and stores and replacing them by frames of foundation; cutting out queen cells or destroying queens, and above all, ventilating the hives. It would not be advisable for any beginner to try these advanced methods except under the guidance of a veteran of the craft, or disasters are sure to follow One may always accept top swarms, and no bees work with the vigour that a swarm does; also they are simply invaluable for comb-building and drawing out wax foundation It is also possible to make artificial swarms of bees, and thus avoid the needless waiting on weather and the caprice of the bees. The simplest way is to take some frames of brood and honey from a strong stock, brushing off the bees in front of the hive Put these frames into a new hive, and fill up both hives with frames filled with comb foundation. Now remove another strong stock to a new stand and put the new hive in its place, and give it a queen or queen cell in thirty-six hours There is also a way of rearing queens in small nucleus hives, then filling up the nucleus hives with frames, and proceeding as above These methods are for advanced beekeepers only, not for tyros

QUEEN-REARING AND QUEEN-INTRODUCTION.—For success in beekeeping a good laying queen is absolutely indispensable, for on the strength of the hive at the time of the honey flow depends any chance of a respectable surplus; a poorly fertile or worn-out queen cannot give the necessary workers Queens are at their best in their second year, and fail generally after that. By the use of the bar-frame hive, the condition of the hive, the laying powers of the queen, and the amount of eggs, brood, and stores can at any time be easily ascertained In all other forms of hive we can only judge by outside appearances or exercise mere guesswork. Should a queen, then, be unfertile, or a layer of drone eggs only, or should the hive be queenless, steps must be taken at once to repair the mischief or the hive will speedily die out. The ordinary amateur should not attempt to become a queen-rearer except through natural swarming. There are so many difficulties in the way, in regard to purity of breed, &c., in relation to fertilization, and in connection with the balling of queens by the bees (that is, adhering to and hugging them to death), that it is better either to get a queen from a good neighbour, or to purchase one from a reliable dealer. But the trouble does not end here, for bees not unfrequently, even though queenless, will ball a new queen and hug her to death. There are various methods of queen-introduction, but in principle they resolve themselves into two kinds, viz. indirect and direct introduction. In indirect introduction the queen is caged upon a comb till the bees become familiar with her, and she is then either quietly released from the cage or she is allowed to eat her way out through a candy plug in the cage, or the bees themselves eat their way into her cage and thus accept her as queen. This method has been found successful, but direct introduction is preferable In all cases of introduction, make sure first of all that the hive is queenless, or else fighting and balling will ensue. If a hive has been queenless for a long time, put in a comb or two of eggs and brood from another hive before introduction · if a queen has to be superseded, take her out and leave them queenless for twenty four hours, till they are thoroughly sensible of their loss When you have got your new queen, keep her warm, and fed with a few workers in a box Have the hive so arranged that you can raise a corner of the quilt without the least disturbance of the bees below it. When it is growing dark, take the queen out of the box away from the food and her attendants for half an hour Keep her warm and handy in a box in your vest pocket Now in the dusk slip quietly to the hive, raise the quilt gently, slide the box containing the queen mouth open and downwards over the frames, wait a second or two, and then slide the queen box off the hive, replace the quilt, and move cautiously away Do not jar the hive in any way, especially by replacing a heavy or badly fitted cover. Do not open the hive for a few days, and in all probability you will be successful, and breeding go merrily on in the hive If by any mishap the queen is balled, she will most likely be thrown out dead from the floorboard

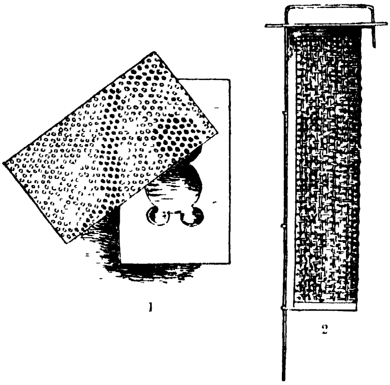


Fig 3 Queen Cages

1, Queen travelling box 2, Abbott queen cage

SUBDUING AND HANDLING BEES—Bees as a rule do not sting unless provoked to do so by abnormal heat or inexpert handling The first great requisite of a beekeeper is to be fearless, then cautious, then patient in handling the bees When about to swarm bees load up their stomachs with honey as if for a journey, and they are usually docile and easy to handle It is better, however, to be prudent, as the writer once swarmed a hive of bees, a cross from the Syrian, which flew incessantly about him all the time, angrily biting and stinging at his clothing from head to foot A black eye or a swelled lip are no ornament even to a beekeeper, and bees *do* sting. A beekeeper's outfit is very simple and inexpensive: a gauze veil to fasten under the coat or waistcoat, with a hole (drawn with tape) at the top just to fix round the hat, a pair of tight-fitting cuffs to keep 'crawlers' from the arms, and a smoker. Gloves of any kind are not desirable; there is no touch of such delicacy as the human hand, and 'mittened cats never catch mice' If you are very timid, rub your hands with some of the patent 'apifuges' before beginning Now suppose you want to examine a hive First charge your smoker with dry brown paper or rags, and light it, setting it on end with funnel upwards, till a good flow of smoke comes out of it, then don your veil and cuffs and go quietly but boldly to the hive Bees may not know individuals, but they certainly recognize those who know their ways and handle them right, show the white feather and they will 'go' for you Now take your smoker and blow in with the bellows a good volume of smoke on each side and in the middle of the entrance to the hive Wait a little, and repeat the same process Now if it is a skep or box hive, see that it is free from the floorboard, then give another puff, tip it up, turn upside down, and look at the hive and its contents till you are satisfied If it is a bar frame hive, take off the cover, and raise the quilt, always pulling laterally and never vertically, and then blow in a little more smoke on the top of the frames Have a frame box handy sitting in same line with the hive, and take out the frames one by one by the lugs, and hold each frame of bees straight before your face for careful examination When you have seen one side perfectly, lower your left hand till the frame stands vertical longways; now give a twirl round as if on a pivot on your left hand; then lower your right hand on a level with the left, and the opposite side is before you, and, what is most important in hot weather, you have made the tender comb lean on its bearings all the time, otherwise it might bag and break away It is most necessary to see that the frames are free from one another and from the hive ledge before lifting them out, or disaster will follow; and guard against crushing bees in your operations. Now place each frame in such a position in the frame box that when you are finished they can be returned to the hive without doubt or trouble exactly where they were taken from. If the

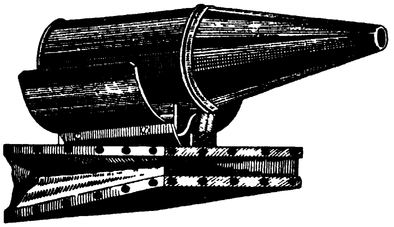
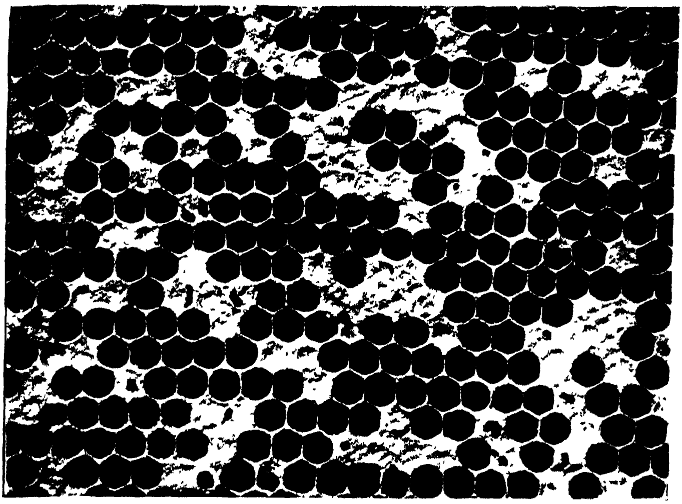
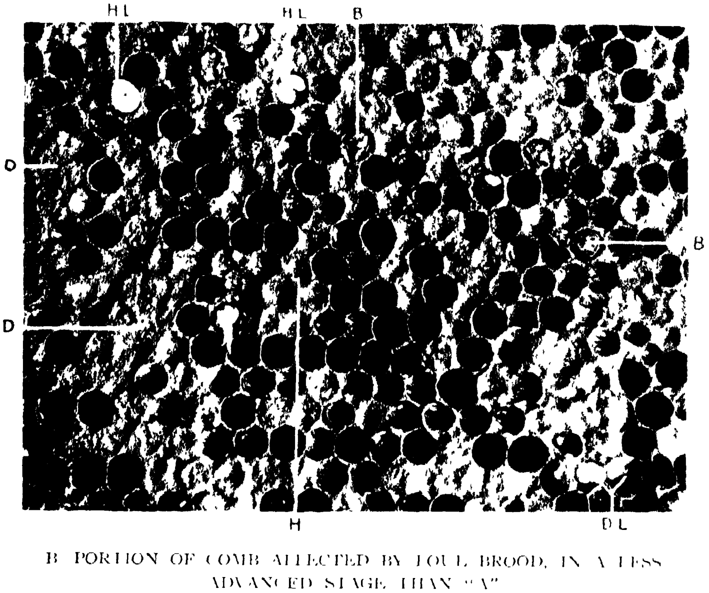


Fig 4 Bee Smoker



A. PORTION OF A COMB AFFECTED BY FOUL BROOD IN AN ADVANCED STAGE

The empty cells are those from which healthy brood has been produced, or which have been occupied by diseased larvae, the remains of which are not discernible in the print. All the capped cells bear the appearance of being diseased. This is indicated by the sunken cappings of the cells and the numerous perforations in the cappings.



B. PORTION OF COMB AFFECTED BY FOUL BROOD, IN A LESS ADVANCED STAGE THAN "A"

The raised cappings indicate that there is a good deal of healthy brood, but the presence of diseased brood all over the comb is indicated by the sunken cappings.

H. A group of healthy cells, other healthy cells being observable all over the comb. D. Two groups of diseased cells, of which there are many more. B. Healthy bees emerging from their cells. H L. Healthy larva. D L. Diseased larvae. Note that these larvae are not lying like the healthy larvae.

(*From "Instruction in Bee Keeping." By permission.*)

bees are very irritable, don't delay, but try another day; never examine a hive unless it is a necessity; plants do not thrive by being pulled up to see their growth.

Driving and Transferring Bees and Combs from a Skep to a Bar-frame Hive.—To drive bees, except to save them from the Gehenna of the sulphur pit, is not a good plan. By the use of the bar-frame hive the work of transferring is rendered child's play alike to yourself and the poor bees. To transfer old combs from a skep to a bar-frame hive is a game not worth the candle; it is a dirty, messy, patchy job at the best, and the old combs cannot compare with the beautiful regular straight combs drawn out from wax foundations. But if you will 'put down' some skeps at the fall to get the honey, this is the way to do it. Get an empty skep of the same diameter as the skeps to be driven. Go to one of the skeps and blow in a little smoke two or three times, free the skep from the floor-board and turn it upside down in a pail, place the empty skep over it, mouth to mouth, and tie a towel firmly round the junction of the skeps. Now beat and rat-tat-tat all over the lower skep with your fingers or a little stick till the bees run up into the empty one. Repeat the process till all the skeps are cleared of bees, then two or three lots of these driven bees, with a good queen and stores, will make a stock for winter keep. By the use of skewers the skeps can be kept a bit apart when driving, and this is called open driving; that described above is close driving.

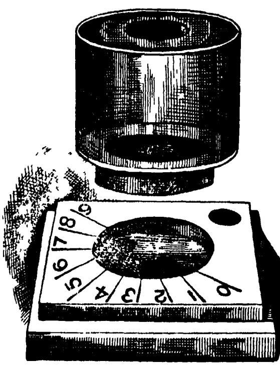


Fig. 3.—Bottle Feeder

Feeding and Wintering of Bees.—In a fairly good season bees should not only lay up sufficient stores for winter, but should in addition give their owners some surplus. But in a bad season, or where they have been deprived of their stores, they should be fed up early in the autumn with plenty of thick warm syrup made from pure cane sugar, and given at night by a rapid feeder. The great point in wintering is to see that the hives are kept perfectly water-tight, for while bees will stand a great amount of dry cold they cannot stand damp. Sound wind- and water-tight hives, plenty of good stores and warm wrappings, contracted entrances and no disturbance, is the order of the day for winter and early spring. It is sometimes judicious to feed with thin bee syrup in the springtime in order to induce breeding, but this also should be done at night, and slowly from one of the bottle feeders. A very good stimulative food is bee candy, made of pure cane sugar, with a spoonful of pea meal stirred in when it is taken off the fire. In all handling of syrup and honey-comb the greatest care should be taken lest the bees be induced to begin robbing, especially in early spring and autumn. There are many devices to stop robbing of weak hives by stronger ones, but there is only one sovereign remedy—*never let it begin.*

Bees, Uniting of.—If the bees are in bar-frame hives this can be easily done. Bring the hives to be united close to each other by moving them a few feet nearer each day. When they are close together remove the queen from one of the hives, and if stores are short in either of the hives feed them up with thick syrup before uniting. Then remove all spare combs that are not covered with bees from both hives. Now space the frames in one of the hives so as to leave room for a full frame of bees and honey between each pair. Give both stocks a little smoke till they are quiet; then quietly insert the brood combs from the one hive into the other in the spaces left vacant for them, and thus both stocks will be completely mixed up. Now drench them thoroughly with fine dry pea flour from a pepper box or other diffuser, put on the quilts, close the hive, give a few puffs of smoke at the entrance, and a few raps on the side of the hive, and leave it severely alone. If there are any signs of fighting, give a little more smoke at the entrance, and a few more raps on the sides of the hive. Some spray the bees with strongly scented (peppermint, &c.) syrup instead of dusting with flour. If the bees are in boxes with fixed frames or in straw skeps they must first be driven out, thrown together at the entrance of the new hive, and dusted or sprayed as they run in.

Diseases of Bees.—We need only mention the two principal ones, namely dysentery and foul brood. Dysentery is mostly caused by either damp in the hive itself or by thin, unsealed, watery, and fermenting stores. The cure for dysentery is to transfer the bees to a comfortable, clean, dry hive, with plenty of sealed stores, or if in early autumn feed up with thick, warm bee syrup. Bees mess their floorboard and entrance when suffering from dysentery, and crawl about weak and aimless-looking. Foul brood is a horrible microbic disease well named 'bee pest', and is most contagious and spreads rapidly. The cappings of the brood combs become sunken and perforated, and the larvæ sicken, die, and become a putrid ropy mass like the grounds of coffee, emitting a foul stench. In bad cases 'stamping out' is the only remedy, bees, frames, &c., being made a holocaust to save others. In milder cases, disinfecting hives and feeding with medicated syrup may be tried, the popular disinfectants being naphthol, beta, phenol, phenyl, &c. Skilled assistance should always be sought in these matters, as there is danger in beginners handling such chemical substances carelessly. Recipes for syrup, bee candy, disinfecting wash, and medicated food will be found in all bee books and in the pages of bee publications.

Enemies of Bees.—*Mice*, especially in winter, are troublesome. They try every way of getting into the hives to rob the stores. Entrances should never exceed ⅜ in in width, and all lifts and covers should fit tightly. Examine on a fine day for intruders. *Wasps*, born robbers and plunderers: these hang about the hives in late autumn, trying to rob and annoy the inmates, who, however, show plucky fight Contract entrances to one bee passage. Keep fittings tight, and kill as many queen wasps in spring as you can.

Blue Tits These little insect feeders are very troublesome, especially in England and in the spring of the year. They sit and tap with their beak on the floorboard, and whenever a bee comes out they nip it up They must be frightened away, or trapped, or shot

Wax Moths hover about the door, and if they get in, render the combs useless with tunnels containing their brood Contract entrances and keep stocks very strong See also arts on Animals, Property in Wild; Apiary, Apifuge, Beehives, Honey, Wax, and for the influence of bees on the fertilization of flowers see Fertilization of Plants. [R. M'C.]

Beesting or **Biesting,** the first milk drawn from a newly calved cow. See Colostrum.

Beet, Parasitic Fungi. See Mangold, Parasitic Fungi

Beetle.—There are numerous species of beetles, which are included in the order Coleoptera For their common characteristics see Entomology

Beetroot (see art Beta)—This is one of the easiest of plants to cultivate, its requirements being a deep, manured soil, the looser the better, and a situation exposed to full sunshine Salt has a decided effect in promoting its growth, but garden beet is not improved by treatment that results in large roots, the smaller roots being in every way preferable The seeds should be sown in drills in the first week in May, if sown earlier the roots are apt to become coarse and stringy The drills should be 1½ in deep, 1 ft apart, and the seeds sown thinly, so that when the plants are high enough to be thinned they may be reduced to a distance of 8 in. apart. After this, all that is required is to keep the ground free from weeds and the surface soil broken, watering it should the weather be dry The plants continue to grow till checked by frost, and the roots should be taken out of the ground about the middle of November, or if left in longer they must be protected from severe frost by a covering of leaves or litter The best plan, however, is to lift the whole crop in November, taking care not to break the roots, and then, after trimming off the tops, laying them in light soil or sand in a shed or anywhere convenient The covering is necessary to prevent the roots from shrivelling. Leaf beet (*Beta Cicla*) is cultivated for its leaves, or rather leafstalks, which are used in the same way as the stalks of celery and seakale, for putting into soups or boiling and serving with sauce. [W. W.]

Beet, Sugar.—The sugar beet is grown in all countries of Europe; in Germany, Austria, Hungary, France, Holland, Belgium, Russia, Switzerland, and Denmark. Even countries as far north as Sweden, and south European countries like Spain, cultivate beet. Lately Italy, Servia, Roumania, Bulgaria, and Greece have commenced sugar-beet growing for manufacturing purposes Eastward beet cultivation exists as far as Persia and Siberia. It has also been tried in Manchuria, Australia (Victoria), the United States of America, Canada, and Mexico The United States produced a few years ago only a few thousand tons of sugar from sugar beet; to-day their production amounts to over 400,000 tons per annum. Sugar-beet culture is also carried on in Chile. Successful sugar-beet growing experiments have lately been made in Natal, Barbados, and the East Indies. Experiments on a small scale have also been tried at the Cape of Good Hope.

It has often been said that the climate of the British Isles is not suitable for the successful culture of sugar beet. That this is not the case has been proved by experiments conducted at several experimental stations, and also by trials made by farmers in different parts of Britain. Analyses made by well-known chemists during the last fifty years have shown that the sugar contained in British-grown sugar beet is not only equal to, but even surpasses, that contained in the sugar beet grown on the continent of Europe.

The botanical characters of this crop are described in the article Beta, and the following are the details of its cultivation. Sugar beet requires a moist soil, but is intolerant of stagnant water. Proper drainage and aeration are essential factors in successful sugar-beet culture The most favourable soil is a medium loam, containing a sufficiency of lime and comparatively free from stones. On heavy clay soils difficulty is experienced in raising the roots in good condition and free from excess of adhering soil. Peaty soils are not at all suitable for beet culture, nor are soils which rest on a stiff clay subsoil A deep soil is desirable, as the roots penetrate to a considerable depth An excess of stones causes forking and uneven development of the root

Preparation of the Soil —The first and most important operation is the autumn ploughing Like other roots, beet follows a grain crop in rotation, and it may be advisable to clean and cultivate the stubble in the autumn before applying the farmyard manure (For details of the process of autumn cultivation see under Turnip Crop) It is then ploughed deeply, and it is an advantage to have a subsoil attachment to the plough to break up and aerate the subsoil. The land may then be left till spring. In April it is harrowed down and grubbed or cultivated, and weeds gathered off, exactly as for other fallow crops. If the land is at all cloddy, the clod-crusher should be taken over it.

The manuring of sugar beet has been the subject of extensive experiments on the Continent with a view to the growth of roots rich in sugar, and from these the following conclusions have been drawn by leading German authorities.

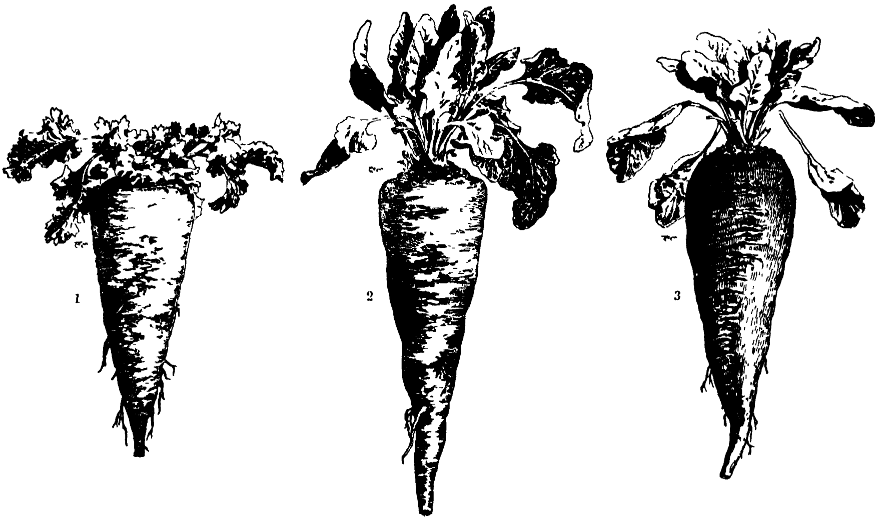


Fig 1 Varieties of Sugar Beet

1, Klein Wanzleben 2, Vilmorin White 3, Vilmorin (a collet rose)

1 Heavy and humid soils should not receive any application of farmyard manure.

2 On light soils farmyard manure should be spread on the stubble in autumn and subsequently ploughed in.

3 Under no circumstances should farmyard manure be applied in the spring

4 Artificial manures for sugar beet should include each of the three manurial constituents, nitrogen, phosphoric acid, and potash

5 The sugar beet takes from the soil the same amount of phosphoric acid as oats, but much more potash and nitrogen

6 The saccharine content of the roots is found to correspond closely to the amount of potash supplied in the manure, and within certain limits the yield of sugar is increased by applications of potash manures If a mixture of potassium and sodium salts is applied, the sugar beet always absorb the potassium

7 Phosphoric acid is necessary to get beetroots of a high quality, but has little influence on the quantity yielded.

8 The specific action of nitrogenous manures is to stimulate a vigorous growth and a strong root development; and the quantity (yield per acre) is dependent upon the presence of nitrogen in a readily available form

9 Beets do not flourish, and are apt to become fingered and toed, on soils where there is a marked deficiency of lime, and some soils require applications of this constituent before its successful culture can be undertaken.

10. In most cases a light dressing of farmyard manure in the autumn is advantageous. This may be supplemented with applications of nitrate of soda, and kainit, and superphosphate of lime

11 The difference between nitrate of soda and sulphate of ammonia in their effect on the crop is not appreciable, but nitrate of soda is preferable where phosphates are included in the

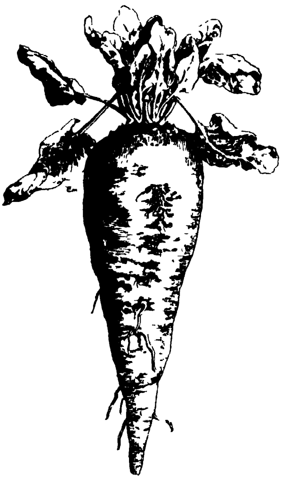


Fig 2 Sugar Beet Vilmorin (Brabant)

artificial dressing. The most effective method is to apply one half of the nitrogen in the quickly acting form of nitrate of soda, and one half in the form of sulphate of ammonia, which acts more slowly and continuously, and it is better to give the former in two or three applications at fortnightly intervals rather than in one large dressing. The early topdressing of nitrate of soda is very advantageous Too late application of nitrate of soda delays the ripening of the crop.

12 Soils which are poor in lime are improved by the use of basic slag Where the soil is rich in lime, phosphoric acid should be supplied in the form of superphosphate.

13. Potash manures are unnecessary on some soils rich in available potash On soils poor in potash, such as light sands, it must be supplied

14 The following artificial dressing would be suitable in the majority of cases, viz —

6 cwt		kainit
3	,,	basic slag
3	,,	superphosphate of lime
1	,,	sulphate of ammonia
2	,,	nitrate of soda

With a moderate dressing of farmyard manure per acre, the artificials might consist of 2½ cwt each of basic slag and superphosphate, with a topdressing of 1 cwt of nitrate of soda

It is important that the seed should be sown in dry weather Sowing may be done any time in April or in the beginning of May, according to local and meteorological conditions It is not wise, however, to plant too early, as it is important that the soil should be at a proper temperature, so that the seed can germinate rapidly Otherwise the young plant is weakened, and is liable to be destroyed by the attack of insects and fungi Generally speaking, the sowing should not be done earlier than the first week of April, nor later than the first week of May If the planting is too soon, a great quantity of the beetroots run to seed, with the result that there is very little sugar in the roots, which have a woody character If planted too late the roots will not mature properly

The seed should be soaked in water for twenty-four hours before planting, in order to accelerate the germination. On the Continent the seed is usually dibbled in, but it is more expeditious to drill it in with a mangel barrow Blanks may be afterwards filled in by transplanting About 25 lb. of seed is required per acre.

In Germany the seed is planted as a rule 4 to 5 in. apart, and six to eight seed grains are put in one hole. The distance between the rows is 14 or 15 in. In Britain the crop is sown in drills, like the mangel, usually 27 in. apart, 8 lb of seed per acre being required The plants should be subsequently thinned out from 6 to 9 in. apart. The subsequent cultivation is the same as for mangels, and the reader should consult the article on that crop for details.

The vegetative period is from 140 to 150 days. The roots are ripe when the leaves begin to fade and turn yellow, which usually occurs in Britain about the middle of September, provided the seed is sown at the proper time. They are raised on the Continent with a long narrow spade. The leaves are cut off, but care must be exercised to leave the root intact. When the roots are injured by careless handling or trimming, fermentation and chemical changes are set up in the injured roots, and 'bleeding' ensues, resulting in loss of sugar. The raising should be accomplished in fine dry weather, and the roots should be left for a few days on the field before storing, in order to get rid of as much moisture as possible. They are then removed to pits or clamps. These are constructed in the same manner as for mangel roots. When piled in clamps they should be slightly covered with straw at first, until all danger of 'heating' is over, when they may be covered over with earth to protect them from frost. See MANGEL.

From 14 to 16 tons roots per acre is considered a good yield, and the saccharine contents varies from 14·5 to 17·5 per cent

Beetroot takes very large quantities, comparatively, of different plant foods from the soil, which must again be returned to it in a proper manner If the beetroot pulp and leaves are used as food for the cattle, the manure produced will return a great proportion of the loss caused by the growth of the crop, but there still remains a certain quantity of important ingredients taken from the soil, which disappears in the process of the manufacture of sugar

A crop of 12 tons of beetroots would take from the soil

Nitrogen	40·5 lb.
Magnesia	18·9 ,,
Phosphoric acid	27·0 ,,
Potash	91·5 ,,
Lime	183·6 ,,
Total	361·5 lb

while one ton of beetroot leaves would remove—

Nitrogen	8·80 lb
Magnesia	5·72 ,,
Phosphoric acid	3·30 ,,
Potash	12·98 ,,
Lime	35·86 ,,
Total	66·66 lb

The total cost of growing the crop varies with the conditions, but may be taken as a rule at about £8 per acre, to which may fall to be added the cost of the transport of the roots to a sugar factory.

CHEMICAL ANALYSIS —The following is the analysis of the slices returned from the factories and used for cattle-feeding —

	Fresh slices		Stored slices	
Water		91·12		91·92
Proteid	·77	—	·83	
Fat	·10	—	·15	
Organic salts	2·55	—	2·63	
Pectin	1·72		1·84	
Gummy matters	·68		·22	—
Starch and uncrystallizable sugar	·55		·16	-
Saccharose	·20		·10	
Woody fibre	1·32		1·63	—
Mineral matter	·99		·52	—
Total dry substances	8·88 =	8·88	8·08 =	8·08
		100		100

Sugar beets are grown mainly for manufacture into sugar. They may also be used for stock-feeding, but their smaller yield as compared with mangel does not admit of their profitable utilization in this way. The pulp which remains after the juice has been expressed is, however, extensively fed to cattle on the Continent. It is deficient in albuminoids, and consequently unsuitable for feeding alone to cattle, although this is practised in Belgium A satisfactory ration would be furnished by the addition of some concentrated cake or meal, and probably cotton cake could not be surpassed for this purpose, as it has the additional advantage that its binding properties counteract the tendency of the pulp to induce scouring Beetroot pulp, with the addition of cotton cake or bean meal, has also proved a satisfactory food for dairy cows When the pulp is kept for a time, lactic acid is developed, and it becomes sour In this condition it is specially suitable for feeding to pigs

The following are the main outlines of the process of manufacturing sugar from beets

The beetroots, as delivered by the farmer to the sugar factory, are stored in a shed, and thence are sent to the washing machine, where they are freed from the adhering earth and dirt After washing, the beetroots are lifted by an elevator to the beetroot-slicing machine. In this machine, which contains a special form of knife, the beetroot is cut into small slices (like vermicelli), which are put into large cylinders called diffusers Twelve to fifteen such diffusers are placed in a circle or in two rows, and the sugar contents are extracted from these beetroot slices with tepid water under pressure The liquor thus extracted from the slices is called raw juice, and this immediately becomes black on exposure to the atmosphere

The raw juice is put into a vessel and treated with about 2 per cent of lime This liming process is to get rid of the organic impurities which are in the raw juice. After this, carbonic acid gas is pumped into the limed juice The lime is thus precipitated, forming carbonate of lime, and the sugar liquor becomes a bright-yellow colour. This process is called 'saturation'. The precipitate is separated from the liquor in a filter press, and the carbonate of lime remains as a cake, which is used as manure, called 'saturation lime' The liquor is subsequently treated in a similar way with smaller quantities of lime until all organic impurities are removed. After the last saturation the liquor is again filtered and treated with sulphurous acid (SO_2), after which it is again filtered to remove the sulphide of lime which this treatment has produced.

The clear liquor which runs off from this last filtration is called 'thin liquor'. This thin liquor is evaporated in a specially arranged series of vacuum pans. The resulting liquor, called 'thick liquor', is then boiled to crystals in the ordinary vacuum pan, and the contents are called 'massecuite' Massecuite contains the sugar crystals floating in a syrup or mother liquor. The crystals are separated from the mother liquor in a centrifugal machine, and are washed with water, steam, or perfectly clear saturated liquor. The centrifugal machines are emptied from the bottom, from which the sugar falls on a travelling belt, and is then ready to be packed into bags, after having been allowed to cool and dry, when it is ready for consumption

WORLD'S CONSUMPTION OF BEET SUGAR.

	Tons
1901 2	6,913,601
1902 3	5,763,416
1903 4	6,096,178
1904 5	4,926,156
1905 6	7,265,136

Total of Beet and Cane in 1905 6, 13,957,269 tons.

YIELD OF SUGAR FROM SUGAR BEET.

Certain selected samples of 100 lb each of sugar beet from the following countries yielded—

	LB OF SUGAR		
	1904-5	1905 6	1906-7
Germany	15 76	15 28	15 69
Austria	14 03	15 27	14 99
France	13 21	13 19	13 75
Russia	14 92	12 80	14 13
Belgium	14 69	13 89	15 14
Holland	15·55	14 47	15·01
Sweden	15 09	15 02	15·87
Denmark	13 77	12 66	13 98
Italy	10 45	9 87	11 50
Spain	12 21	13 30	13 20
Roumania	10 87	13 10	13 64
Other countries	12 00	10 91	14 10
Average per cent	14 60	14 27	14 79
North America	11 61	10 64	11 79
Canada	10 00	12 55	9 02

The total acreage under sugar beet cultivation in Europe has undergone a great increase in the past twenty-five years. In 1880 the cultivation was confined to less than 2,000,000 ac. From that time there was a steady increase to the maximum of 4,849,881 ac in 1901-2, since when there has been some decline.

AVERAGES AND RESULTS OF THE EXPERIMENTAL SUGAR-BEET GROWING IN THE UNITED KINGDOM.
Carried out by SIGMUND STEIN, Liverpool.

Table I.—AVERAGE YIELD PER ACRE.

Year.	Tons per acre	Year	Tons per acre
1897	16·07	1903	14 50
1898	16·03	1904	16·86
1899	16 09	1905	16·00
1900	19 01	1906	18·00
1901	19 04	1907	17 71
1902	15·90		

Table II.—ANALYSIS OF ROOTS.

Year.	Country	Weight of roots with leaves, in grams	Weight of roots without leaves, in grams	Degrees Brix (dry matter)	Specific Gravity.	Quantity of Sugar in 100 parts of the juice	Quantity of non-Sugar in 100 parts of the juice	Quotient of Purity
1898	British ...	1371	843	19·05	1·079	16·54	2·51	86·82
	German	974	539	19·02	1·079	16·32	2·70	85·80
1899	British	1644	902	19·00	1·079	16·30	2·70	85·78
	German	957	611	18·30	1·076	15·45	2·85	84·42
1900	British	1525	790	19·52	1·081	17·07	2·45	87·45
	German	1064	557	20·00	1·083	17·38	2·62	86·90
1901	British	1441	851	19·38	1·180	17·02	2·36	87·82
	German	1112	621	17·66	1·073	14·76	2·90	83·53
1902	British	1326	878	19·29	1·080	16·80	2·49	85·11
	German	1042	492	17·43	1·072	14·79	2·64	82·74
1903	British	1516	933	19·93	1·083	17·28	2·65	86·98
	German	1100	560	19·70	1·082	16·87	2·83	85·63
1904	British	1491	892	20·25	1·084	17·65	2·60	87·04
	German	988	616	20·90	1·087	18·32	2·58	87·66
1905	British	1611	996	20·13	1·084	17·50	2·63	87·30
	German	927	495	19·30	1·080	17·00	2·30	88·08
1906	British	1574	827	20·01	1·083	17·45	2·56	86·85
	German	1071	544	19·60	1·081	17·23	2·37	87·91
1907	British	1944	890	20·30	1·085	17·90	2·40	88·17
	German	872	424	19·70	1·081	17·14	2·26	88·63

[S. St.]

Beeves.—This word is used to denote fattening cattle, but is seldom heard in the everyday language of the stockowner. It lends itself more to poetic diction; as in Longfellow's lines—

> 'Men have no faith in finespun sentiments
> Who put their trust in bullocks and in beeves'.

Beggars. See VAGRANTS.

Tuberous Begonia, single

Begonia.—The tuberous begonias have become very popular garden plants in the last twenty-five years. They have been bred from several species found on the Andes of Peru and Bolivia, and the changes wrought in the size, form, and colours of the flowers are quite astonishing. They are so easily grown, and flower so freely and continuously, that they are almost as popular as the Scarlet Geranium. For summer bedding it is usual to raise them from one-year-old tubers planted in March in boxes or open frames and kept rather warm until they have grown a few inches high, when they are hardened off and transferred to the flower beds. They require a light, rich soil, the looser it is in the beds the better, and they must be kept uniformly moist. On the approach of cold weather the tubers should be lifted, dried by exposure, and then cleaned and placed in dry soil or sand, out of the reach of frost, till they are started again the following spring. The best varieties are grown in pots for the decoration of the conservatory. It is easy to raise a stock of plants from seeds, which should be sown in heat in February, and the seedlings grown on in an intermediate temperature. Skilfully handled plants thus raised will flower freely when six months old. [W. W.]

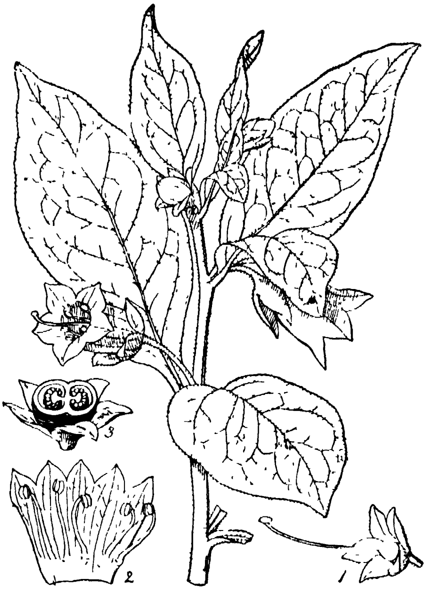
Belgian Horse, a breed of horses supposed to be descended from the old Flanders black horse. His native district is the valley of the Meuse, and horses bearing the characteristics of the breed are also to be found in the north-eastern provinces of France, in Italy, and in the United States. The black stallions largely employed by funeral undertakers in Britain, of which there are said to be about 700 in London alone, are selected from horses of this breed and imported from Holland and Belgium.

The following are the main points that distinguish the breed. The head is of medium size, with small eyes, mouth, and nostrils. The forehead is short and slightly hollowed between the prominent ridges of the eye sockets. The neck is strong, arched, and muscular. The body is closely coupled with broad chest and powerful shoulders, and best answers to the description 'blocky'. The legs are short and stout, and sparsely 'feathered'. The colour is variable, and the size ranges from 14½ to 16 hands. The action is brisk, but the pace rather short.

There is a considerable variation from the true Belgian type in the different provinces in which the breed is now established. The Belgian bred in the province of Hainaut is essentially a draught animal for heavy lorry work, but in more southern districts a lighter type of horse is more commonly seen, *e.g.* in the variety known as Bornage. In the Ardennes the size of horses of the breed is still further reduced. On the other hand, the Brabançon, or variety of the province of Brabant, is even larger and heavier than that described above.

Bell, Dr. Patrick.—From early times men have exercised their ingenuity and skill in contriving machines to facilitate the ingathering of the harvest. Out of a long list of such men the Rev. Patrick Bell holds the place of honour, as he was the first to bring a really serviceable machine to the aid of the farmer. He was born in 1801 at the farm of Mid Leoch, Auchterhouse, Forfarshire, where his father was farmer. He was educated at St Andrews University, and it was in his student days, while at home on holiday, that he was impressed with the great expense and labour involved in securing the grain crop, then cut down by scythe or reaping hook. Taking his idea from the garden shears, he was able in 1827 to produce his first machine, which was set to work on his father's farm. The inventor's idea was a series of double-edged shears. The upper blades, thirteen in number, were firmly bolted to the crossbar, while the under blades moved to right and left. A continuous set of cutters was thus formed, and the grain, drawn in by a reel in front, fell on a sloping canvas and was delivered at the off side. The reaper found its way to various farms in Forfarshire, one was sent to Ireland, and four to America. After finishing his career at the university he was licensed to preach, and in 1843 he came to Carmyllie. Here his inventive genius did not forsake him, for in the attics of the manse he had his workshop, and in his leisure hours he devoted himself to various mechanical problems. He made a small meal mill for grinding his oats, a flour mill for his wheat, and a coffee mill for his coffee—all of which were regularly used. At an early period of his life he manufactured sugar out of beetroot which he had grown, inventing and making the necessary machinery. His university, recognizing his great invention, conferred on him the degree of LL.D., while the Highland and Agricultural Society presented him with a piece of silver plate and £1000, as the inventor of an 'efficient reaping machine'. He died at Carmyllie in 1869. [G. S. M.]

Belladonna or **Deadly Nightshade** (*Atropa Belladonna*).—This plant is a most deadly poison, and belongs to the same order as the potato, namely Solanaceæ. It is a herbaceous perennial which dies down every year, and renews itself from a stout persistent stock. Belladonna is frequent on chalky soils and in the neighbourhood of ruins. In summer the plant is bushy, with stout stems 2 or 3 ft. high. The leaves are large and egg-shaped, emitting a peculiar heavy smell. The flowers are dingy purple bells, drooping, and about 1 in. long. The berry fruit is dark and glossy, quite like a cherry in size and shape. All parts of the plant are poisonous, from the presence of the deadly alkaloid *atropin*. An ointment containing atropin is frequently smeared round the eye when it is necessary to dilate the pupil. A curious fact about Belladonna is that opium acts as an antidote to it, and vice versa. In cases of poisoning by Belladonna the stomach-pump and emetics must be had recourse to as speedily as possible. [A. N. M'A.]



Deadly Nightshade (*Atropa Belladonna*)

1, Calyx and corolla. 2, Corolla, spread open. 3, Section of fruit

Bell Flower. See Bluebell.

Bellis, the genus of plants to which the daisy belongs. The double daisies are very serviceable in the garden, being excellent for defining borders or to plant round the margins of flower beds. They have been greatly improved by gardeners, the flowers of the best varieties being two inches across, very double, and coloured pink, red, white, or variegated. They may be raised from seeds, the different varieties coming fairly true, sowing the seeds in the autumn and transplanting the seedlings in spring in the places where they are to flower. Or a stock of plants may easily be raised by division, for these plants have the same sturdy constitution as the common daisy, from which indeed they have all been evolved. They are most effective from March to May, but they are more or less in flower for half the year. See also DAISY. [W. W.]

Bell Wether.- This term arose out of the once prevalent custom of attaching a bell to the neck of the sheep which led the flock.

Belly, Inflammation of. See PERITONITIS.

Belt. See SHELTER, PLANTING FOR.

Belted Cattle. Belted cattle are represented in the British Isles by a strain of Galloway cattle, and on the continent of Europe and in America by the Dutch Belted breed. As it is possible that the belted strain of Galloways may have arisen from the Dutch Belted cattle, it will be convenient to describe the latter first. The origin of the Dutch Belted cattle is obscure, but they are said to have existed as a pure breed since the 17th century, chiefly in the control of the nobility of Holland. They are known in their own country of Holland as the 'Lakenfield' or 'Lakenfeld' cattle, the word 'laken' meaning a sheet or cloth passing round the body. The belt is of pure white hair, and in perfect form extends from the shoulders to the hook bones, completely encircling the body, and including the fore part of the udder; it varies in width, sometimes narrowing to less than 12 in. With the exception of the belt the animal is entirely black, like the corresponding strain of Galloways, but unlike the Galloway it is horned.

The Dutch Belted cattle are rather larger than Ayrshires and Guernseys and smaller than Holsteins. Typical cows weigh from 1000 to 1200 lb., and bulls up to 1800 lb. They are suited to rich lowland grazings, and are probably inferior to the Ayrshire in ability to fend for themselves on inferior upland pastures. Pre-eminently a dairy breed, their milking qualities are said by Shaw (Study of Breeds) to be excellent, but in the Pan-American Dairy test of 1901, in which ten breeds participated, five Dutch Belted cows made the following record in 120 days:—

Yield of milk	24893.5 lb.	Breed rank	eighth
Churned butter	977.1 ,,	,,	tenth
Total solids	3966.17 ,,	,,	ninth

According to this test seven other dairy breeds produced more milk. Some remarkable individual yields are, however, mentioned by Plumb (Types and Breeds of Farm Animals). One cow produced 32 qt. per day on grass alone, and a herd of twenty-five or thirty cows and heifers in New York State averaged from 800 to 900 gal. of milk per head per annum. The milk does not reach a high average of butter fat, but it is good for cheese and butter making, and excellent for calf-feeding on account of its relative richness in bone- and muscle-forming constituents. The feeding qualities of the Dutch cattle are fair up to two years old, after which age they kill badly, as they are not bred for beef, and tend more to the dairy form when they mature. In America, where opportunities arise for crossing with British breeds, they have exhibited a remarkable prepotency, and according to one breeder, if they are mated with any cattle of a solid colour, such as the Devon or Red Poll, the belt is almost invariably reproduced. An exceptional example of prepotency occurred in the herd of the Ohio State University. A Dutch cow was mated with a bull of the equally ancient Jersey breed and a white belted calf produced, exactly like its dam except for a small black spot in the middle of the white. The Dutch Belted cattle are not widely distributed. Even in their native Holland they are not numerous, and in America they are probably the least popular of the dairy breeds. They are found, however, in the United States, Canada, and Mexico; their numbers are greatest in the Eastern States, particularly in the State of New York. The interests of the breed are promoted by the Dutch Belted Cattle Association of America, with headquarters in New York. A scale of points has been drawn up by this Association for the guidance of breeders. The scale accords 8 per cent of points for colour, which is required to be black except for a clearly defined white belt, the belt to be of medium width, beginning behind the shoulder and extending nearly to the hips. In judging bulls, five points additional are given for perfection of belt.

BELTED GALLOWAYS. Belted cattle were found in limited numbers in different parts of the United Kingdom in the early 19th century. Youatt, as quoted by Low, mentions that belted cattle were to be found in Somerset, a brown and white breed of old standing, both horned and polled, and well suited for the dairy. Another authority speaks of black belted cattle in the marsh lands of the east of England, probably immigrants from Holland, brought by refugees from the Low Countries. Belted cattle were also found in Wales, the result, it is said, of crossing the Welsh cattle with the White Forest breed. At present the only British cattle characterized by a white belt or sheet belong to a strain of Galloways chiefly found in Northumberland, and here and there in the south-west of Scotland. According to Professor Wallace (Farm Live Stock of Great Britain) this is an old and valued strain of the Galloways, which seems to have existed from time immemorial. It is difficult to avoid the conclusion that it may have originated from a cross of Dutch Belted cattle, though no documentary evidence is available to substantiate the assumption. The known prepotency of the Dutch cattle lends weight to this view, and the frequent traffickings between Scotland and the Low Countries in the 17th and 18th centuries would provide opportunities for the importation of a few Dutch Belted cattle. The horns, the only essential difference, would disappear with the predominance of Galloway blood.

About the year 1800, belted Galloways were introduced to Northumberland by Lady Melville, and for a time they were known as Melville Galloways. They are now found in greatest numbers in the valley of the south Tyne and around Haltwhistle. The marking is not so distinct as in Dutch cattle; sometimes the belt does not encircle the body, and 'white feet and tail ends are often seen'. Those belted Galloways of Northumberland are said to be larger

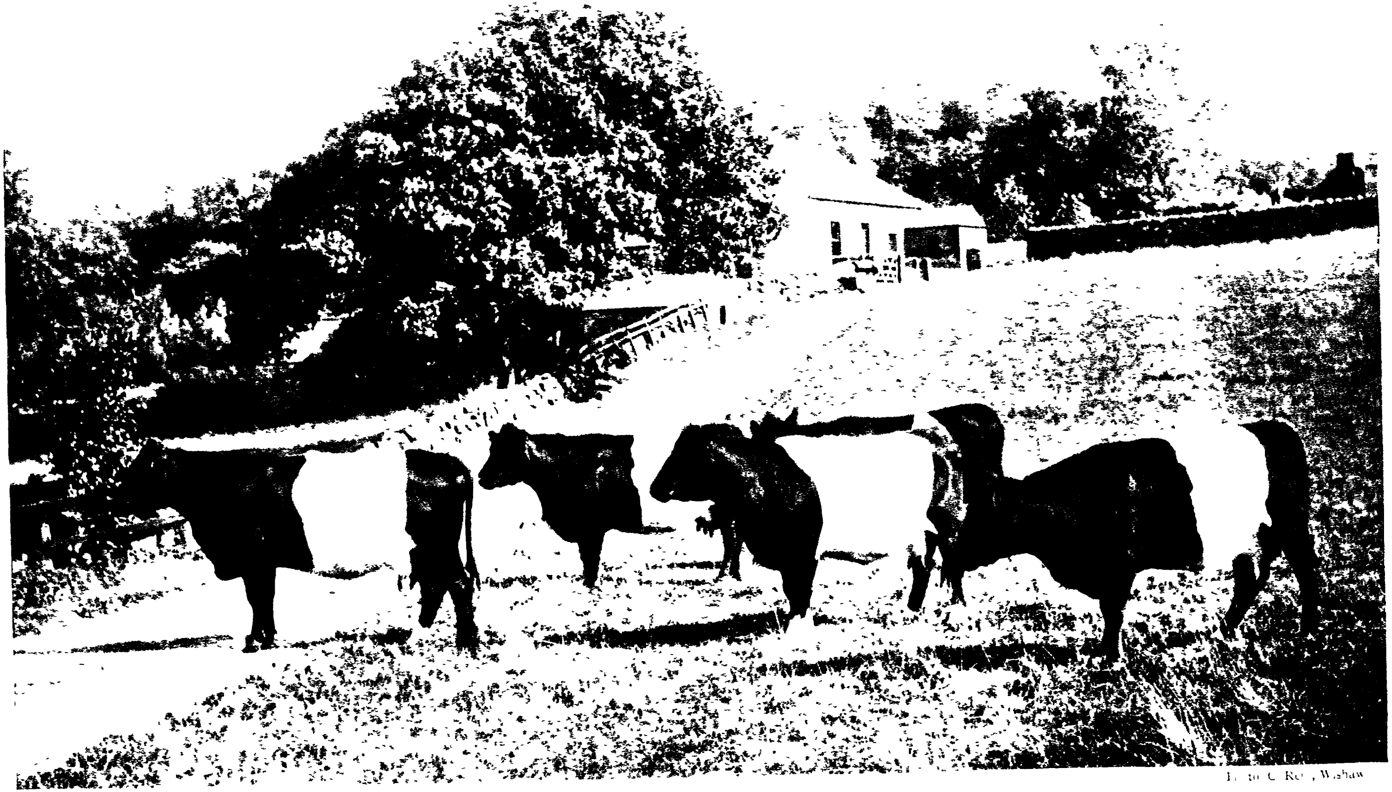


Photo C. Reid, Wishaw

BELTED CATTLE

BELONGING TO THE HERD OF THE HON. FRANCIS BOWES LYON, RIDLEY HALL, NORTHUMBERLAND than the black Galloways, less wild, but quite as hardy, and better milkers. The white belt appears to dominate the pure black in crossing, and according to the late James Biggar of Dalbeattie, a family of white-belted females threw white-belted calves for fifty years, though nearly all the bulls used were entirely black. The Hon. F. Bowes Lyon of Ridley Hall, Bardon Mill, Northumberland, owns a herd of pure-bred, white-belted Galloways with exceptionally perfect markings, the result of painstaking selection and mating. Dun-belted Galloways are not unknown, and a bullock of that colouring was first in his class at Smithfield Show in 1905. [R. B. G.]

Bent, the common name of several species of grasses belonging to the genus Agrostis. See Agrostis

Bent and Starr Acts. Towards the end of the 17th century sundry lands lying along the sea coast of Scotland had been ruined by an inundation of sand driven from adjacent sandhills, and in particular two-thirds of the Barony of Culbin, in Morayshire, had been so overwhelmed with blown sand that no trace of the mansion-house, outhouses, or orchards could be seen (Chambers, Domestic Annals). To this day this tract is still a barren wilderness of sand, though the traces of cultivation can still be seen where the sand has blown off (St John, Wild Sports of the Highlands) In consequence of this calamity an Act of the Scots Parliament was passed in the year 1695, entitled an Act for the ‘Preservation of Meadows, Lands, and Pasturages lying adjacent to Sandhills’, whereby the pulling of Bent, Broom, or Juniper off sandhills, either by the proprietors of the ground or anyone else, is prohibited under the penalties in the Act In 1742 an Act of the Imperial Parliament (15 Geo II, c 33) was passed whereby similar provision was made to prevent the cutting or pulling of Bent or Starr on the coasts of England, under reservation of certain prescriptive rights in the county of Cumberland. By this Act the Scots Act of 1695 was re-enacted as regards Scotland and rendered more effectual. Not only the person pulling the Bent, &c., but anyone within eight miles of any sandhills in whose custody such Bent, &c, is found, is liable to the penalties set forth in the Act. [D B.]

Benthamia fragifera or **Cornus capitata** is a Chinese tree related to the British Dogwood In the British Islands it is too tender to thrive in the open air except in the warmer parts. In South Cornwall it forms a tree with the habit of an apple tree, and in spring is clothed with creamy-white flowers not unlike single roses but thicker in the petals, and in the autumn with fleshy dull-red fruits not unlike in shape and consistency those of the strawberry. These fruits are not, however, fit to eat, but the tree is worth growing on account of its handsome flowers. [W. W]

Bentham's Pine. See Pine

Benzoic Acid and **Benzoates.** — Benzoic acid is found widely distributed in nature in aromatic gum resins, such as gum benzoin, balsam of Tolu, and dragon's blood; in essential oils, such as those of cloves and cinnamon; &c. It is also prepared artificially, and at the present day the artificial product has practically displaced the natural one. It is a typical aromatic acid, with a pleasant aromatic odour. Its chemical formula is $C_6H_5\,COOH$.

Like the closely related salicylic acid, benzoic acid is used as a preservative and antiseptic. It is used as a food preservative for very similar purposes to salicylic acid, but is not used to anything like so great an extent as that acid. Like salicylic acid it is a mild preservative, without any poisonous action on higher animals when it is present in only small quantities. Both the free acid and its sodium salt are used The free acid is a white, feathery, crystalline substance, with a faint, pleasant, aromatic odour. It volatilizes readily on heating It is only slightly soluble in water. Sodium benzoate is readily soluble in water

As a preservative, benzoic acid or sodium benzoate has been used for wines, beers, fruit juices, jams and jellies, ham, bacon, potted meat, sausages, and ketchup It is seldom found in these substances in this country, as, where a preservative is used, it is nearly always salicylic acid In certain other countries, in which the use of salicylic acid is prohibited, it is said that benzoic acid is more largely employed. Benzoic acid is not poisonous in small doses, though it may be injurious to persons whose excretory functions are deranged, or who, on account of personal idiosyncrasy, are specially susceptible Arguments for and against its use as a preservative have been brought forward, very similar to those used in the case of the more important salicylic acid

Benzoic acid is used as an antiseptic in surgery, and was used as such long before its use as a preservative for foods was known Certain well-known old preparations for application to wounds, such as the balsams, which have been in use for long periods, owe their effect in whole or in part to the presence of benzoic acid. As an antiseptic it appears to be rather more powerful towards most organisms than salicylic acid. It is also used in medicine for internal application for certain purposes, such as the disinfection of the urinary passages, and is administered in doses up to 15 grains [J H]

Berberis, the genus of plants to which the Common Barberry (*B. vulgaris*) belongs. See Barberry

Bere, the common name of four-rowed barley See Barley

Bergamask Sheep, a race of sheep found in Italy. The wool is white and of medium staple; the legs are long, and the body presents a quaint appearance The most remarkable features of this sheep are its long, pendulous ears and its long, white face

Berkshire Knot or **Nott,** a breed of sheep which formerly ranged over the Downs of Wiltshire, Hampshire, and Berkshire From this breed, as well as from the Old Wiltshire horned breed, the Hampshire Down has been developed by crossing with the Southdown. See Hampshire Down.

Berkshire Pigs.—Amongst those English breeds of pigs which have secured much more than a local reputation, that which has been named after the county of Berkshire will rank high. During the sixth and seventh decades of the last century a considerable proportion of the best bacon manufactured in the English and Irish bacon factories was the produce of pigs through whose veins coursed more or less of the so-called Berkshire blood. The origin of the Berkshire, like that of most of our present-day pure-bred pigs, is shrouded in mystery to a great extent. In the early days of the Royal Agricultural Society of England, when the prizes were offered for pigs of any type or colour, a black-and-white pig with sandy spots was often successful. This class of pig was found in the south-midland and western counties of England, those bred in Berkshire, Somersetshire, and adjoining counties partaking more of the black colour, whilst those bred in the counties of Oxford, Warwick, Leicester, Northampton, &c., showed the white and sandy spots to a greater extent. This may have been due to the infusion of a larger proportion of the blood of the grizzly grey, sandy, and black-spotted pig found in the latter counties, which has been in comparatively recent years crossed with pigs of a lighter colour, and has been known as the Tamworth, as well as to an increased proportion of the blood of the white pig, with blue spots or markings on the skin, which at that time was locally known as the Cambridgeshire or Fen breed. Although this variation in colour was very noticeable, there was comparatively little difference in the other characteristics of the Berkshire pig of that period, which was long and deep in the body, rather long in the head, light in the jowl, neck, and forequarters, fine in the bone and hair, of which last it had a fair quantity, and it furnished a carcass with a large proportion of fine-quality lean meat. Some of the old bacon-curers claim that with the aid of this class of pig they were able, even with the old-fashioned system of curing, to produce bacon and hams fit for the gods. It is recorded against the Berkshire boars and sows of that day that they were of a somewhat savage disposition, but against this drawback it was possible to set the fact that they were very prolific, and that the sows were good mothers and free milkers, whilst the young pigs were hardy, growing and thriving in a most satisfactory manner, and needing comparatively little care and attention. It is true that the system of pig-keeping, if such a thing as a system could be said to exist, was totally dissimilar to that which is now followed by up-to-date pig-keepers, and this might have rendered the Berkshire pig of that period a greater favourite than a pig of a similar type and character would be at the present time. Half a century or more ago the life of the ordinary fat pig was at least twice as long as now, when we have reduced the so-called store period at least one-half, and in many instances to a fourth of the nine to twelve months during which the farm pig was supposed to be profitably employed in simply increasing its size, and in rendering itself fit to convert the more valuable food, such as meal produced from the grinding of barley, wheat, peas, &c., into pork. It was apparently considered at that time that it was much more profitable to have two separate periods in the life of the pig, the first being called the store period, when the pig was fed on a comparatively small quantity of inexpensive food, in addition to the refuse from the farmhouse, dairy, &c., and any other food which it might pick up in its wanderings about the farm premises, and at times even in the villages. This store period would be of varying duration, being regulated as a rule by the time of year in which the pig happened to be born. The late summer pig would often be made ready for killing when some fifteen months old, whilst the spring-born pig would be at least eighteen and frequently twenty months old ere it met its fate at the hand of the countryside pig-killer. This variation in the age of the fat pigs was due to the fact that nearly all the fattened pigs were killed during the winter months, as it was at that time impossible to convert the pork into bacon and hams during the warm weather when the fly was prevalent. The fatting period would commence as soon after harvest as there was a supply of inferior corn, as this, when ground into meal, was the principal feeding-stuff on which pork was manufactured. These remarks will explain why the Berkshire pig was so great a favourite with our forefathers. It lent itself admirably to the requirements of the farmer and pig-keeper, in that it consumed a very considerable quantity of farm produce which, without the pig, would have been wasted, and it furnished a long, deep carcass heavily laden with fat, which could be converted into bacon and hams so saturated with salt that it could be kept over the summer by hanging from the beams in the old-fashioned farm kitchen, or stowed away in the capacious chimneys of the farmhouse. In the latter place it acquired that smoky flavour which has become so generally appreciated, and which has led our American friends to invent and manufacture so-called 'liquid smoke' to be applied to the bacon, and thus save the somewhat heavy cost of smoking it in the usual way by the burning of oaken wood, sawdust, &c., as is adopted by the bacon-curers and the wholesale dealers in bacon.

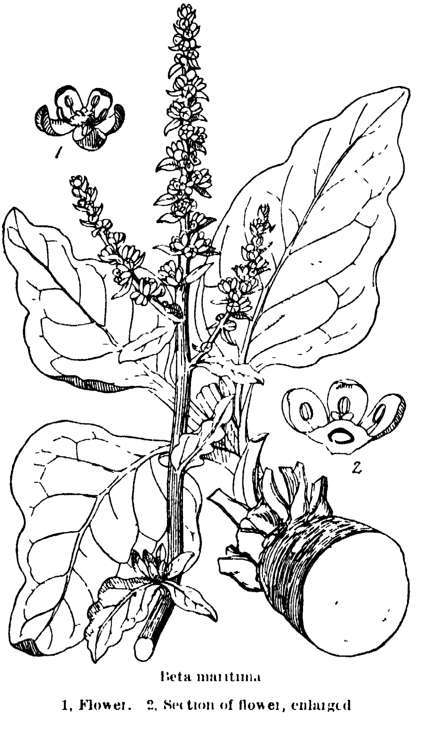
Some thirty or forty years ago, a combination of several circumstances brought about a great change in the type and conformation of the Berkshire pig. Amongst these were the introduction of the mild-curing system and cold-air chambers, which enabled bacon-curers to carry on their work during the summer as well as in the winter months; the great change in the style of living amongst all classes, due to increased circulation of money attending higher wages and extended commerce and manufactures, when smaller joints and what was considered to be more easily digested and leaner meat was demanded. Added to these, and perhaps the most potent of all, was the demand of those of our American cousins who, having made piles of enormous dimensions, had turned their attention to the breeding of so-called fancy stock. Shorthorns were one of the first varieties of English stock to be imported by them; and as the majority of the breeders of Shorthorn cattle in those days were men of means, and to a greater or lesser extent hospitable, and epicures, they were breeders of Berkshire pigs, which at that period furnished choice pork, bacon, and hams. In those piping times, maize was king in the States, and the conversion of it into exportable merchandise one of the problems of the hour. What, then, could be more natural than the suggestion that one or more Berkshire pigs should form the luckpenny in a deal for Shorthorn cattle, especially as our American cousins had failed thus far to produce a type of pig at once so handsome and stylish as the Berkshire, and withal one apparently so well qualified to convert their corn into pork and lard. As the two forms of food into which the major portion of the fat hogs were manufactured in the States were barrelled pork and lard, the agents of the Americans naturally selected Berkshires of the thick-backed and fat type; further, as their main object was to obtain a certain weight of pork, whether produced in the fore or the hind quarters, or even in the head and jowl, they chose pigs short in the head, heavy in the jowl, thick in the shoulders, and with fine hair and bone. With the major portion of these buyers or agents from the States the question of cost did not appear to enter, so long as they obtained pigs of the unusual and pronounced type. Under these circumstances the breeders of Berkshire pigs could not be blamed for attempting to produce the kind of animal which they could sell at such remunerative prices.

Another fact which had a very considerable influence in rendering the short-headed, wide-backed, and fat-carrying Berkshire fashionable, was that the general run of those moneyed Americans who had taken up the hobby of pig breeding and showing had little or no knowledge, even if it troubled them, of the commercial or practical points of a hog; their one desire appeared to be the owner and exhibitor of prize-winning animals of a different character to the ordinary run; and if these purchases were made at extravagantly high prices, the greater was the interest that was taken in them. As the majority of the judges at our live-stock shows are either breeders, or—in too many cases—dealers in the various breeds of stock, it is only natural that the market demands have a very considerable influence on the type of animal to which the prizes are awarded. To such an extent is this the case, that a well-known judge, when asked to explain a decision, remarked, 'You must follow the fashion if you want to be again appointed as judge'. The judges of Berkshire pigs seemed to be imbued with the idea to so great an extent, that the prize-winning Berks were mainly of the American type. In order to win these prizes and to share in the good thing, breeders adopted varying systems; some contented themselves with selecting for stock purposes the neatest and shortest sires and dams—if these possessed snub noses and heavy jowls so much the better, since these points are usually associated with thick necks and shoulders, and fat backs. Other breeders were said to have bought boars of the Small Black breed to secure the compact type of Berkshire; in this they were successful, save that in some of the pigs so bred the markings were not complete. In order to explain the word 'markings' it may be advisable to state that the correct colour of the Berkshire pig, as declared by the society formed for the purpose of caring for the interests of its breeders, is black with white points or markings, *i.e.* a white star on the forehead, white feet, and white hairs on the tip of the tail. At the present time even more importance is attached to these white markings than was the case when the Herd Book first appeared. This is shown by a regulation recently adopted, that at a first-class show a Berkshire pig deficient in its markings should not have a prize allotted to it. Some of the old-fashioned breeders contend that this rule, if strictly carried out, would be bound to have a bad effect on the commercial value of the hog, and that this last is the most important point for the breeders of pigs, as of all other varieties of live stock, to study, as from it and not from the show yard must be sought the really continuous and profitable market. One would think that this was a convincing argument, especially when the fact is taken into account that this peculiar colour or marking is not natural to the Berkshire, nor does it afford the slightest indication of any particular points possessed by the correctly marked pig, nor of the pork or bacon which its carcass would furnish. It would appear to be one of those peculiar fancies which have been inseparable from the exhibition of most kinds of live stock—fancies which have greatly tended to reduce the commercial and practical value of all the various departments of our shows. Some thirty years since, this question of the fancy and the commercial points of the Berkshire and other pigs was thoroughly thrashed out in the agricultural press, when the most noted firm of bacon-curers in England wrote several letters and gave copies of photographs of the form of a suitable and an unsuitable type of pig for conversion into bacon, as well as other photographs showing the proportion of fat and lean meat to be found in the two types of pigs. The breeders of the fashionable style of pig naturally championed the cause of their favourites, which they declared to be as near perfection as possible, using as an argument the fact that Americans, who were admittedly the most extensive hog-raisers in the world, continued to import at very high prices the prizewinners at our shows. Notwithstanding the refusal of the breeders of the fashionable Berkshire to admit the truth of the bacon-curers' contention, they have certainly of late years been making most serious attempts to bring their pigs into line with the requirements of the curers, requirements which are very similar to those of the purveyors of fresh pork. The majority of the breeders appear to have adopted the most effectual way to improve the form and substance of their pigs, and at the same time to preserve their special type and character, by selecting for breeders the young pigs, which are comparatively light in the jowl, neck, and shoulders, long and deep in the body, square in the hind quarters, and carrying a large proportion of lean meat; whilst a few are said to have followed the unwise practice of the breeders of Berkshires of a quarter of a century since, and have used boars of a black breed, of greater size, but no more suitable for the manufacture of the finest quality of pork and bacon. The infusion of a small quantity of the blood of pigs of this type would most probably more quickly increase the size of the pig to be altered, but the results would as surely be of a less satisfactory and permanent character; and besides this, the chances are that the introduction of this alien blood would result, after the first generation, in a return to the original black-and-white colour of the old-time Berkshire, or at all events to a considerable increase in the number of the young pigs possessing white spots of varying size on the skin. It might very likely with justice be claimed that against this might be set a probable improvement in the prolificacy and milk-giving qualities of the Berkshire sows, and further that the slow growth of the young pigs, which is said to be a decided weakness of the fashionable Berkshire, would be eliminated; but these failings could be remedied with equal ease and greater certainty by the continuous selection of parents possessing in a marked degree the good qualities desired to be retained. The mere fact that the breeders of Berkshires have become alive to the probability of there still being some little room for improvement in their favourites is almost certain to ensure the necessary change, and the modern Berkshire pig may regain the very high position in the porcine world which it worthily held for so many years. [s. s.]

Berry, Rev. Henry (1792–1836), was the originator and editor of the British Farmers' Magazine, and a warm advocate and successful breeder of Shorthorn cattle. For some time he was rector of Acton Beauchamp in Herefordshire, but eventually resigned his living and devoted himself wholly to farming on an extensive scale in Worcestershire. His chief contribution to agricultural literature was his Improved Shorthorns and their Pretensions Stated. This admirably written work describes the results of his personal observation and researches, and furnishes statements of facts which still possess some value for the live-stock breeder of to-day. [J. B.]

Beta.—A small genus of herbaceous plants belonging to the nat. ord. Chenopodiaceæ and embracing about ten species. The flowers are bisexual, and arranged singly or in small axillary clusters on long terminal spikes. The calyx of the flower is adherent at its base to the ovary, the upper parts being free. The five stamens present are perigynous and attached to a fleshy disk. The fruit contains a single albuminous seed. When ripe, its walls and the fleshy disk and base of the calyx become more or less hard and woody. The fruits of several flowers which are crowded together often grow into a compact cluster. Such compound clusters are the beet and mangel 'seed' of commerce. All the species have smooth, thick leaves and strong, fleshy roots.

To this genus belongs the common sea beet (*Beta maritima*, L.), which grows on shingle and cliffs by the seashores in northern Europe. The plant is a herbaceous perennial, with a strong, branched, fleshy rootstock and angular stems, which are usually spread on the ground in a circle, the ends only ascending. The leaves are a dark-green colour, the lower ones having broad petioles and rhomboid-ovoid blades with acute tips; the upper leaves are lanceolate. The flowers are small and green, of the general structure described above.



Beta maritima

1, Flower. 2, Section of flower, enlarged

The name *Beta vulgaris*, L., is given to the cultivated biennial forms of garden beet, sugar beet, and mangel wurzel. They appear to have been derived from a variety of beet found in the Mediterranean region, and named *B. vulgaris*, L., var. *maritima*, Koch. The latter plant differs from the northern *B. maritima*, L., in being annual or biennial in habit, in the more upright character of its stems, and in having a simple taproot. The garden variety known as chard beet, and grown for its thick, fleshy midribs, which are cooked and eaten as a vegetable, is sometimes considered a distinct variety (*B. vulgaris*, L., var. *Cicla*). The experiments of Schindler, Proskowetz, and others, however, suggest that all these wild and cultivated plants are forms of a single species. [J. P.]

Betel Nut.—The Betel Nut Palm (*Areca Catechu*, L.) is cultivated over wide areas in Southern India, Ceylon, Siam, and the Malay Archipelago. The tree, which grows to a height of 80 ft. and attains a girth of 12 to 15 in., is grown from seeds. The seed beds are carefully prepared from finely broken soil mixed with leaf mould, and the seeds (fully matured nuts from old trees) planted about 9 in apart during April. In October the seedlings are transplanted to any convenient part of the garden, placed about 2 ft. apart, and, at the end of the rainy season, removed to their permanent position and planted about 6 to 7 ft. away from each other. Plantains, which develop rapidly, are interplanted with the palms for shade purposes. The tree begins to bear fruit when eight to ten years old, and continues to fruit freely for thirty to forty years. The fruits occur in bunches, each tree bearing from two to three bunches, and each bunch containing about 300 nuts. When ripe, the fruit, which is the size of a small hen's egg, is yellow, smooth, and shiny; the inner husk is fibrous, and rather difficult to remove. The nut is principally used as a masticatory, and is supposed to act as a stimulant to the digestive organs. In preparing the nut for consumption it is first carefully husked and scraped free from fibre, and then thrown into a large copper pot containing boiling water and a little lime. The boiling is continued for two to three hours, and the nuts then removed by a perforated ladle, which allows the liquor to drain back into the pan. The nuts are afterwards sliced, and the slices dried in the sun. In preparing the bolus small pieces of the nut are mixed with a little lime, cardamoms, catechu, and turmeric, and the mixture wrapped in a leaf of the Betel Pepper vine. [H. W.]

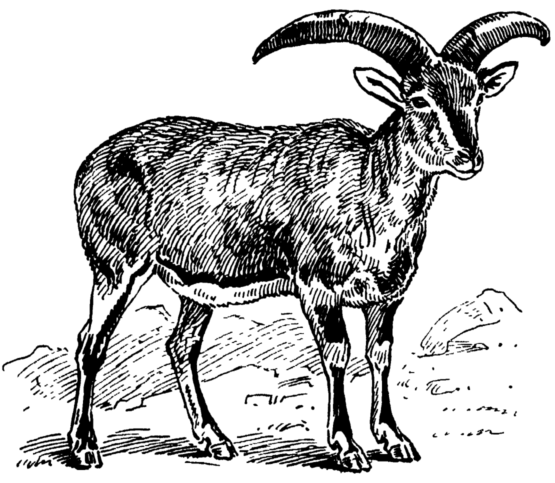
Betterment.—The word 'betterment' has come to be used in a special technical sense to indicate the principle of distributing taxation to cover the expense of certain beneficial public works upon the owners or occupiers of the property which is benefited. The proposal is a modified system of taxation of land values, the increases to be taxed being confined to those which can be definitely attributed to an improvement carried out by a public authority. It is subject, however, to the same difficulty as regards the determination of the amounts of increased value. An improvement which may be beneficial to a site occupied by a shop need not be beneficial, or equally so, to dwelling-houses or offices. That the value of a site is a function *inter alia* of the kind of building upon it, which represents comparatively permanent investment, is a fact to be borne in mind when any suggestions relating to taxation on the basis of the value of land are being considered. It will be convenient to distinguish between three kinds of betterment. In the first place there is that which definitely benefits specific individuals, the improvement having been undertaken mainly in their interests. It is commonly recognized that the cost in this case may justly be charged to the persons who gain. An example of an Act embodying the principle is the Housing of the Working Classes Act, 1890, which allows a special rate to be charged to the owner of a house previously obstructed when the obstruction is removed, the basis of the rate being the improvement in value, which is to be settled by arbitration. A second kind of betterment refers to the intended results of expenditure incurred mainly for a particular district smaller than the area taxed by the authority concerned. In this case, too, it is a generally accepted principle, which has been carried out in certain legislation, that a special rate may reasonably be imposed upon the area affected. The third class of betterment, about which most controversy has taken place, relates to the beneficial effects upon the value of property incidentally caused by public works which were undertaken for other objects. Special circumstances can easily be imagined in which this kind of betterment should be rated, and there are many examples to hand, but the proposal to confer a general power upon rating authorities to differentiate assessments with such betterments in view is of doubtful expediency. Such a power might be abused, and even if it were not, suspicions of partiality might arise. To some extent the effect of a betterment rate is secured in such circumstances by what is known as 'the method of recoupment', which protects the owners of the bettered property against unjust exactions. The method of recoupment is carried out by the authority concerned securing powers to purchase compulsorily property within the region of improvement to an extent beyond their needs for the improvement. It is intended that the property should ultimately be sold again when the betterment has come to fruition. Complaint is, however, made that the business goodwill attached to certain properties is a serious obstacle in the way of the smooth and profitable working of this system. Besides, compulsory purchase on valuation must be a costly mode of acquisition if all possibility of a real grievance on the part of the ejected owner is guarded against. The assertion that the adoption of the principle of 'betterment' carries with it that of 'worsement' is hardly convincing. By the principle of worsement is meant that individuals should have the right to recover from public authorities any loss due to the depreciation of their property which can be shown to be connected with public improvements. Thus a new thoroughfare would divert traffic, and thereby it might diminish the business done by shops in an adjoining street. But observe that such grievance as is caused by worsement exists now. It would not be intensified by betterment rates; rather it would be reduced, since the burden on the property damaged would be reduced.

[S. J. C.]

Betula. See BIRCH.

Bharal or **Burrhel** (*Pseudois nayaur*), sometimes called the Blue Sheep, is an interesting link between true Sheep (Ovis) and Goats (Capra). It inhabits the Himalayas and Tibet from an altitude of 10,000 ft. and upwards. Horns are present in both sexes, those of the male being rounded, nearly smooth, and directed upwards and backwards, then slightly inwards at the point, forming an open sigmoid flexure;

while those of the females are small, and directed upwards and outwards. There is neither beard on the chin nor mane on the neck. The general colour is brownish in the summer and almost slate-grey in the winter. The underside and inner sides of the legs are white. There is a considerable quantity of black down the front of the legs, and some also on the muzzle, the tip of the tail, and frequently a stripe along the side above the belly. The tail is longer and more hairy than in wild sheep, and under the stimulus of excitement is carried erect. The Bharal differs from the true sheep principally in having no suborbital gland and no depression on the skull for its lodgment. In this, as in the structure of the horns, it approaches the Aoudad or Barbary Sheep (see ARGALI), but differs from that species in the shortness of the tail and the absence of the mane on the throat and fore legs. From the goats the Bharal may be distinguished by certain structural details connected with the back of the skull, as well as by the possession of glands in the inguinal region. Bharal do not hybridize with domestic sheep. [R. I. P.]


Bharal (*Pseudois nayaur*)

Bibionidæ.—A family of flies (Diptera), the males generally jet-black, with large contiguous eyes, the females black, yellow, or red, with much smaller eyes. The larvæ are very unlike the typical fly maggots, resembling legless caterpillars, with very distinct horny head and numerous spiracles, and they often occur in great masses congregated together. The best-known examples are *Bibio marci* and *Dilophus febrilis*, the Fever-fly, so called because it was supposed to occur with especial frequency in the rooms of fever patients. The latter has been accused of injuring hops in Kent. It often occurs in horse and cow manure, and when in excessive numbers it is dangerous to plants to which such manure is applied. [C. W.]

Bield.—A Scotch term for a place naturally protected from storms and cold, as, for example, an overhanging bank under which sheep can find shelter. An old Scotch saying runs, 'Better a wee buss than nae bield'. Flakes interlaced with straw or covered with coarse sacking are frequently used as a bield for ewes suckling early spring lambs.

Biennial Plants.—This term is applied to all plants which perfect their vegetative organs during the first year of their life; during the second year they devote themselves entirely to the production of the reproductive organs, and then die. The seed sown in spring germinates, and during the first season of growth produces a fleshy taproot crowned by a rosette of ground leaves These leaves manufacture food and store it away in the fleshy taproot for use next season. During winter the plant remains dormant, but in the following spring the bud in the centre of the leaf rosette becomes active, and using up the food previously stored in the root, becomes a long, flowering shoot. This flowering shoot brings the fruits and seeds to maturity. In so doing, the whole plant is exhausted and dies, and there is nothing left to continue the growth but the seeds for reproduction. Biennial plants are the root crops of agriculture, e.g. Turnip, Swede, Carrot, Parsnip, Mangel. The potato is not a biennial, but a perennial. Biennial seeds are also common, e.g. Burdock, Spear Thistle, Wild Carrot, Wild Parsnip. In dealing with biennial weeds the important point to notice is that they always start from seed; therefore to prevent recurrence of such pests, seeding must be prevented. [A. N. M'A.]

Biestings or **Beestings.** The first milk drawn from a newly calved cow. See COLOSTRUM

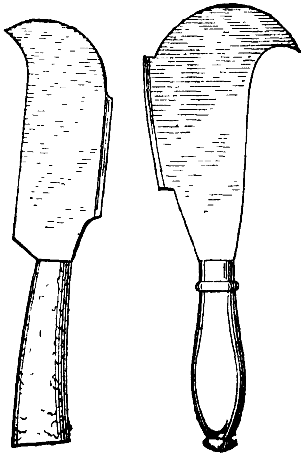
Bigg, a term sometimes applied to bere or four-rowed barley.

Big Leg, a popular name for the disease known to veterinary surgeons as lymphangitis. See LYMPHANGITIS.

Bilberry, Blaeberry, Blueberry, or **Whortleberry** (*Vaccinium Myrtillus*) is in Britain the commonest species of the genus Vaccinium (nat. ord. Ericaceæ), which also includes the Bogberry (*V. uliginosum*), the Cranberry (*V. Oxycoccos*), and the Cowberry or Red Whortleberry (*V. Vitis idæa*). The Bilberry is a small glabrous shrub, usually about 1 to 1½ ft. high, with small, deciduous, ovate or slightly cordate leaves, globular pale-greenish-white flowers tinged with red, and globular blackish berries covered with a glaucous bloom and crowned by the short calyx-teeth. Indigenous throughout all central and northern Europe and Siberia, it is common in all parts of Britain except the eastern counties, and is in the Scottish Highlands often found over large tracts associated with bogberry, heath, and heather. Occurring extensively on waste lands suitable for planting, it is one of the least troublesome of weeds to contend with, as it can easily be cut back, and then does not grow quickly or large enough to interfere with the proper development of the young trees planted. In woodlands its appearance is a sign that the leaf-canopy formed by the tree-crowns is already becoming opened up to too great an extent to properly protect the soil against incipient exhaustion; but when the woods get opened up further, the bilberry has usually to give way to other weeds, which oust it on the leaf-canopy getting further broken up and allowing more sunlight to fall on the ground [J. N.]

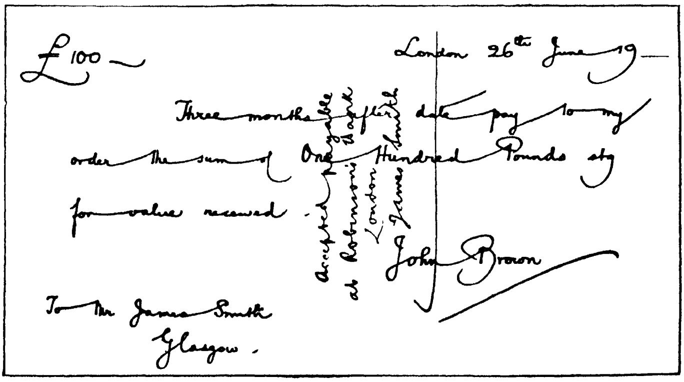
Bilberry (*Vaccinium Myrtillus*)

Billhook.—An implement used for cutting hedges and lopping branches, for faggoting, and wherever the wood to be cut is of small diameter. The length and degree of curvature of the blade depend on the district.



Billhooks

Bill of Exchange, often spoken of simply as a **Bill,** is defined in law as 'an unconditional order in writing or printing addressed by one person (called the drawer) to another (the drawee), signed by the person giving it (the drawer), requiring the person to whom the instrument is addressed (the drawee) to pay on demand, or at a fixed or determinable future time, a sum certain in money to, or to the order of, a specified person (the payee) or to bearer'. The bill is said to be accepted when the drawee



£100 — London 26th June 19—

Three months after date pay to my order the sum of One Hundred Pounds stg for value received.

John Brown

To Mr James Smith Glasgow.

Accepted payable at Robinson's Bank London James Smith

Bill of Exchange

writes across the face of it the word 'accepted' along with his signature; and he may also add words indicating where it is to be payable. A bill to be legal must be drawn on stamped paper or have a stamp attached, the value of the stamp varying with the amount of the bill, from 1*d.* for £5 up to 1*s.* for every £100 or fraction thereof. The payee or person in whose favour the bill is drawn may at once take it and get it discounted at a bank, or he may endorse it over to another person—say in payment of a debt—by writing his name on the back of it, being then called the *endorser*, while the person to whom it is thus assigned is the *endorsee* or *holder*. A bill, being a negotiable instrument, may thus pass through a number of hands by the process of endorsement; and the security of subsequent endorsers is increased by the endorsements of those preceding them, since each endorser is liable for the amount of the bill, in the event of the failure of the accepter or drawee to pay it at the due time. The last phase in the negotiation of a bill is usually its being discounted with a banker, who deducts an amount known as discount, being an equivalent for the use of the money that he pays over or advances until the due date of the bill, when he expects that the full amount will be paid him. It is common to state in the bill that the sum mentioned is 'for value received', but this is not necessary for the validity of the instrument. In determining the due date of a bill, or that at which it has ultimately to be paid, an extension of time known as the three *days of grace* has to be taken into account. A bill drawn and accepted merely to raise money, and not in payment of a debt, is called an *accommodation bill*. The convenience of bills of exchange is so great that they are protected by special privileges. In general the holder of a bill can proceed against the drawer or accepter in a summary manner, without the common forms of an action at law. As soon as a merchant or trader fails to pay his bills when due, the fact is made public, and he is virtually considered and treated as a bankrupt. The holder of the bill, by proceeding against him, can also compel him to pay or take refuge in legal bankruptcy.

Bill-sticking.—A proprietor is entitled to prevent the sticking on his property of bills or advertisements without his leave, and he can vindicate his right without the necessity for proving actual damage sustained. By statute, the sticking, or giving instructions to stick, indecent or obscene pictures or advertisements is an offence, and any constable may without warrant arrest anyone found committing the offence. [D. B.]

Biltong, the name given by the Boers in South Africa to meat which they preserve by drying. It corresponds to the 'pemmican' of the American backwoodsmen. The meat is cut into long strips and the blood expressed. Flour and salt, and sometimes spice, are then rubbed into the strips, which are afterwards suspended in the sun to dry. Thus prepared the nutritive value of the meat is lessened, but it has the advantage that in a dry climate it will keep for a long time without undergoing putrefactive changes.

Bimetallism.—Bimetallism is a system of coinage in which two metals exchangeable at a fixed rate are taken as the standard of value instead of one metal. The two metals which have been so united, and which it has been proposed so to reunite, are silver and gold. Bimetallism must be contrasted with symmetallism, a term less known to the public, which, however, is convenient in technical discussions on currency. A symmetallic system is one in which the standard of value consists of a fixed quantity of one metal plus a fixed quantity of another. In recent times a kind of bimetallism was tried by the Latin Union. This was entered into in 1865 by France, Belgium, Switzerland, Italy, Greece, and Roumania. It was agreed that the coinage of both gold and silver, in the ratio of 15½ units by weight of silver to 1 unit of gold, should be undertaken by the members of this union. In 1871 the coinage of silver had to be restricted, for reasons connected to some extent with the Franco-Prussian war. The Latin Union, no doubt, had some effect in keeping the ratio between the market values of the two metals fairly constant. The United States adopted a bimetallic ratio of 1 : 15·25 in 1786, changed it in 1792 to 1 : 15, in 1834 to 1 : 16·002, and in 1837 to 1 : 15·988. Gold alone was made the standard of value in 1873. The conclusion that a law rendering gold and silver exchangeable at a fixed weight ratio would preserve the market rate of exchange at a fixed ratio may be deductively demonstrated from the premiss that such a law would render the demand for either metal for the currency compensatory, or equilibratory, with reference to other forces affecting the value of the two metals. If the demand for gold rose, immediately there would be a disposition to use silver instead of gold in payment of debts. Gold would leave the currency and silver would take its place until the disposition for the decreed ratio to break was counteracted. The sole ground of apprehension as regards the maintenance of the ratio would be that the currency might be drained of one of the metals. It is questionable whether the currency needs of one leading country would be adequate to secure for long a fixed ratio between gold and silver all over the world by means of a bimetallic law. Hence the proposal to bring about bimetallism by international agreement. The countries concerned would have to be prepared to re-rate the two metals if any revolutionary change took place among the forces settling the value of either. Unfortunately re-rating would be disturbing.

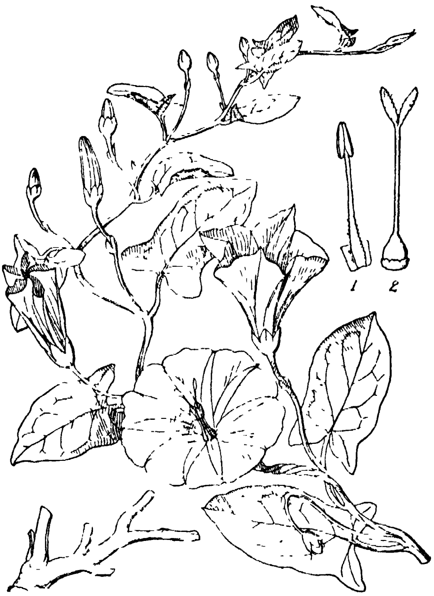
The strongest reason for bimetallism is the advantage of a fixed par of exchange between gold-using and silver-using countries. Large and frequent disturbances in the foreign exchanges are exceedingly discouraging to commerce. Importers of wheat might be able to buy from India at a certain price in silver, but at the time payment was made the gold price of silver might have fallen sufficiently to turn the profit into a loss. No doubt the exporter could avoid the risk, but the risk would still exist, and if borne by a mercantile bank some charge would be made which would discourage the trade. This reason for bimetallism was to some extent removed by the closure of the Indian mint in 1893. The rupee was thereby transformed into a token coin, its value being regulated by that of gold, which circulates in the country only to a very limited extent. So far the authorities have been remarkably successful in keeping the rupee at a steady gold value, and trade with India has been considerably facilitated in consequence The argument for bimetallism, derived from the confident belief that it would facilitate trade with silver-using countries, has been fortified by the allegation that Eastern prices are customary prices, and that a fall in the value of silver has operated in conjunction with customary prices as an export bounty on Eastern exports, *e g* on Indian wheat. But perhaps the argument which did most to render bimetallism popular was that which relied on the assumption that high or rising prices were good for the community and low or falling prices bad for the community. High prices generate economic activity and low prices depression, it was alleged Those who hold these views are known technically as inflationists Inflationism has had considerable influence in the United States, and to a large extent among the agriculturists of the West It is true that a sudden and unforeseen drop in agricultural prices may bring about agricultural depression, but it is not so evident that a steady fall in prices, which is more or less anticipated, can have the same effect. And steady prices possess accompanying disadvantages Steady prices, when associated with a falling real cost of production, mean that frequent readjustments must be made in wages merely in order to keep constant the share of the produce obtained by the agricultural labourer The drop in agricultural prices after the early seventies was most striking It is affirmed that monetary causes account for this to a large extent. France was forced out of its silver policy by events succeeding the Franco-Prussian war At the same time Germany and the United States adopted the gold standard, and since then gold has won its way still further into the world's currencies But it must be remembered, on the other hand, that a development of banking, notably in the extended use of the cheque, has economized the use of gold as a medium of exchange. It is even affirmed by some that this development, which, other things being equal, would raise prices, has probably counteracted the monetary stringency which the increased adoption of gold as the standard of value, and the strengthening of the gold basis of certain monetary systems, would occasion. Were this the case the fall in agricultural prices would have to be explained by a lowering of the cost of production and transport. Intermingled with inflationism in the United States was the alarm of the silver interests, but as this has no special bearing on agriculture it need not be noticed here We ought, however, just to mention the Bland Act (1878), and its successor the Sherman Act (1890), now repealed, which provided for the State buying of silver in the United States, and were aimed at augmenting the currency and raising prices all round as well as the price of silver. For the silver legislation the agricultural interests were in no insignificant degree responsible.

Another argument put forward in support of bimetallism is that by its adoption the standard of value would be rendered steadier in the sense that it would be less given to oscillations about its general level. This contention is true only on certain assumptions. A greater unsteadiness of value in money might result to the countries which had previously been gold monometallic if the fluctuations of value were much greater in silver than in gold. [S. J C.]

Bin, Corn.— A convenient box or chest used in stables for the purpose of containing oats or other provender for horses.

Binders. See Reaping Machines.

Bindweeds. -This name is applied (1) to the genera Convolvulus and Calystegia, (2) to a species of the genus Polygonum. The stem of a bindweed is deficient in skeleton, and so a support is required if the leaves are to be sufficiently exposed to light, and starvation prevented. To meet this requirement the stem has the habit of describing a spiral line round a neighbouring plant, which thus becomes a mere prop for the bindweed, enabling the latter to expose its leaves freely to the light. A plant twining in this way round a crop plant, and using the crop plant as a support, may evidently lead to considerable loss of produce.



Small Bindweed (*Convolvulus arvensis*)

1, Pistil 2, Stamen and portion of corolla

The Small Bindweed (*Convolvulus arvensis*) is a certain indicator of dry, light soil, through which its underground stems creep extensively, appearing like thin white worms. The air stems come up in twos or threes and spread out, groping round for a support. When contact is obtained, the stem grows and lengthens rapidly, twines round the support as it grows, and spreads out its arrow-shaped leaves to the light. The flowers are conspicuous pale-pink bells about an inch in diameter. Each flower when ripe forms a round capsule with four dark triangular seeds, which contain a principle poisonous to man and beast alike. These seeds are harvested with the grain crop, and, unless special precautions are taken, the grain is unfit for meal-making on account of the poisonous contamination.

In certain districts where the soil is light this bindweed is one of the worst pests of the grain crop. To mitigate the nuisance, hand-pulling may be resorted to, also deep ploughing and collecting with harrows. As soon as the air-shoots appear they should be hoed, and if the hoeing is continued so as to check the air-shoots, the weed may ultimately be destroyed

The GREAT BINDWEED (*Calystegia sepium*) is a twining plant, with a perennial creeping, cord-like rhizome, commonly called its root, by means of which it is multiplied with great rapidity, in the same manner as couch grass. The leaves are dark-green, arrow-shaped, with the ends of the posterior lobes snipped off, as it were, in an irregular way The flowers, large and white, are enclosed within a pair of bracts, of such large size that they have been taken as the characteristic of a genus, and are now employed to distinguish this plant from Convolvulus Its stems are tough and strong, and when they twine round the branches of other plants, strangle them, causing the production of deep spiral furrows

The plant is a troublesome weed, preferring moist land, which it soon overruns if neglected The best means of extirpating it is by continually forking, or otherwise removing its rhizomes If, however, the shoots are destroyed as fast as they appear, the vitality of the plant becomes in time exhausted, even though the rhizomes remain in the ground They are purgative, and may be used as a substitute for jalap or scammony.

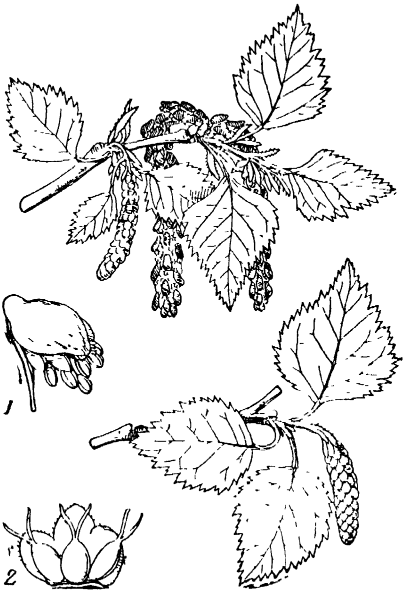
BLACK BINDWEED, or Climbing Buckwheat (*Polygonum Convolvulus*) – This is an annual twining weed allied to Buckwheat, and belonging to the order Polygonaceæ It is easily distinguished from the Small Bindweed by the presence of tubular membranes round the nodes of the stem. These tubular stipules are characteristic of the whole order Polygonaceæ The plant springs up from seed in cornfields and waste land, indeed wherever the land is stiff The flowers are in inconspicuous racemes, and when ripe the fruit is a *triangular* achene which looks like a seed Black Bindweed is the only twining plant with a triangular fruit. In the oatfield this weed strangles the crop plant and shades it; thus considerable loss of crop may accrue. [A. N. M'A.]

Biology, the science which investigates the phenomena of life, both animal and vegetable. See BOTANY and ZOOLOGY.

Biota. See THUJA.

Biotite, a mineral belonging to the mica group. See MICA.

Birch (*Betula*), a genus of the group Betulaceæ (nat. ord. Amentaceæ, or 'catkin family'), which includes only the Birch and the Alder (which see). The flowers are monœcious, the male catkins being cylindrical and usually pendulous, with broad shortly-stalked scales containing eight to twelve stamens, and the female catkins being cylindrical and compact, each scale having two small scales inside and usually only three flowers, without perianth. The scales of the fruiting catkin become enlarged and three-lobed, and fall off with the small, flat, seed-like, winged nuts. Of the twenty-five species, all found as trees or shrubs throughout the temperate and arctic northern regions, only two are indigenous to Britain, the Common or Silver Birch (*B. alba*) and the shrub-like Dwarf Birch (*B nana*), which seldom grows over 20 ft. high, and is not uncommon on the bogs and moors of the Scottish Highlands, although rare in northern England, and not indigenous to Ireland. The Common or Silver Birch is by common consent allowed to be the most graceful and elegant of all our woodland trees. It grows to about 50 ft high, and up to about 2 ft. or more in diameter. Its slender, pendulous branches, drooping gracefully even under the slight weight of their small, sparse, light-green, rhomboidal or triangular to broadly cordate foliage, often quivering in the breeze like aspen leaves, and its shining, silvery-white bark, which readily peels off in layers before advancing age fissures the



Birch (*Betula alba*)

1, Male flower 2, Female flowers

rind of the trunk and darkens its appearance, make it contrast well with the beauties of our other forest trees. And nowhere is the contrast greater or more pleasing than when Birch is seen against a background of, or in admixture with, Scots Pine, its great natural associate in all those parts of Britain where they are indigenous. Its most beautiful ornamental effect is perhaps, however, attained when Birch occurs in small isolated groups, or when one or more trees grow by the margin of some rivulet, river, pond, or lake, where it often assumes so pendulous a habit as to be called a ‘ Weeping Birch’. But it is also of considerable value as a timber tree, although its wood is soft and light (sp. gr. 0·95 green, 0·64 seasoned) and is not at all durable unless impregnated with creosote or naphthaline. It grows quickly, and reaches maturity at about fifty or sixty years of age.

Formerly it was, like Alder, much used for gunpowder charcoal, but it is now mostly employed for cabinet-making and furniture when of large size (and especially when burred and rich grained), for wagon-making, herring-barrel staves and crates, clog-soles, turnery, reels and bobbins, the brushwood and branches being also used for the heads and handles of brooms. As it seeds very freely, its light winged seed (a pound contains about 800,000 seeds, though only having a low germinative capacity of about 10 per cent), wafted far and wide by the wind, makes it spring up freely wherever there are blanks or cleared spaces in adjoining woods or stretches of waste lands. But it does not seed itself under the shade of thick trees, for it is the most light-demanding of our broad leaved trees, and just as unable to thrive under overshadowing as is the Larch, the most light-demanding of our conifers. Its ability to seed itself freely on clear patches is sometimes a serious inconvenience in Scots Pine woods under natural regeneration, where the invasion of the less profitable Birch is not desired; and owing to its strong reproductive capacity it is difficult to suppress when once it has secured a firm foothold. It coppices freely, and also throws up suckers, and is often found along with the Goat Willow among the underwood in copses. It is one of our hardiest trees as regards soil, situation, and climate. On dry, sandy or stony soil a variety (*B. a. verrucosa*) with warty twigs prevails, while on moist, sandy-loamy or peaty land a pubescent variety (*B. a. pubescens*) is the more common, and attains the larger dimensions. But even this latter kind does not thrive well if the soil-moisture be stagnant. Plants can be easily grown by collecting the seed, produced freely almost every year, late in September or early in October, storing it in a dry and airy place, and sowing it broadcast in March on beds of light, friable, well-pulverized sandy or peaty soil. It needs little or no earth-covering, but only firming down with the back of a spade. Seedlings can be pricked out as yearlings, and planted out at 2 to 3 ft. high after standing two years in the transplant lines. Several North American and Himalayan species have been introduced, the largest and most ornamental of which are on dry soil the Paper Birch (*B. papyracea*), and on moist soil the Golden Birch (*B. lutea*) having bronze-yellow bark, and large, broad, toothed leaves. Both were introduced from Canada, the former in 1750 and the latter in 1767. [J. N.]

Birch.—Parasitic Fungi.—LEAF RUST.—The leaves may become coated with rust, golden-yellow in early summer from the formation of summer spores (uredospores), slightly darker later when the winter spores (teleutospores) are produced. The fungus is one of the rust fungi (Uredineæ), which has its cluster-cup stage (æcidiospores) on leaves of larch and other conifers. See LARCH and PINE—PARASITIC FUNGI.

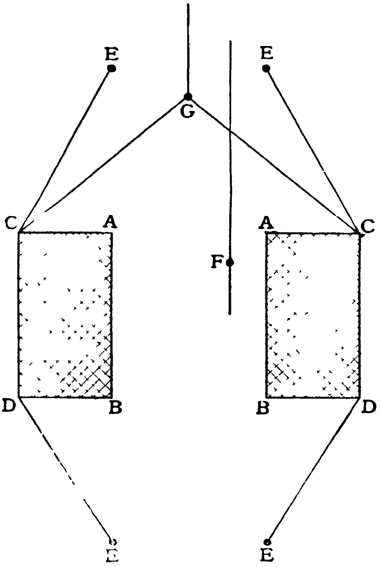
WITCHES' BROOMS are familiar growths on birch. At first sight they suggest a bird's nest, but on closer examination they will be found to consist of masses of short twigs. In spring the brooms generally bear leaves before other parts of the tree, and on these leaves a fungus (Exoascus) may generally be found, producing its spores in time to infect healthy leaves as they emerge from the bud. Sometimes the witches' brooms are produced by a gall-mite related to the ‘big bud’ mite on hazel and black-currant. If considered injurious or unsightly the brooms can be cut off and burned.

Another species of the same family of fungi may cause leaf spot on birch, one form being easily observed by its bright-red colour.

WOOD ROT.—Old and broken trees frequently carry white bracket fungi, measuring sometimes 1 ft. across, and belonging to the group of Polypores (*Polyporus betulinus*). These and other species of the same family of fungi are an indication that the fungus producing the bracket-like fruit bodies is living in the wood and destroying it. (See FUNGI.) The trees are therefore of little value and ought to be removed, since they only serve as centres for infection of more valuable trees. [W. G. S.]

Birch Gall Mite. See ERIOPHYES RUDIS.

Bird-catching.—Numerous different methods of catching birds are practised by dealers throughout the country. Birdlime and various forms of spring trap are much used, but the favourite instrument of the professional bird-catcher is the ordinary clap nets. These consist of a pair of nets, varying in length from 6 ft. to 50 ft., and in width from 3 ft. to 6 ft. The mesh is usually from ½ to ¾ in., and the nets are coloured in such a way as to render them inconspicuous when lying on the ground. When they are to be used, the two nets are laid out upon the ground with their lower sides, A B, parallel and inwards, and at such a distance that when drawn together the poles, A C, B D, should overlap about 18 in. The lower sides are fixed to the ground by means of irons, and the poles, A C, B D, are fastened to the ends of each of the nets. The upper end of each of these poles, C, D, is attached by a guy-line to a peg E situated at some distance off, and in a straight line with the lower side of the net. When thus arranged, the nets are held taut, but can turn freely about their lower sides A B, so that they can be drawn to and opened without difficulty. When this is fixed, a pull-line has to be arranged, so as to enable the nets to be worked from a distance by the bird-catcher. For this purpose a line is attached to the top, C, of the nearer pole of each net, the other end of which is in the hands of the operator. To ensure the nets moving simultaneously, however, it is usual to work them with a single pull-line which divides into two at G, near the nets, so that the whole line is in the form of a Y. Between the nets bait is placed, and also a 'brace-bird' as a decoy. This brace-bird is tied by a piece of string several inches in length to the end of a small wooden stick, F, which, by means of a second line, the brace-line, can from time to time be jerked upwards, so as to make the brace-bird flutter in the air and attract the attention of its wild congeners. The brace-bird and stick are placed between the nets, if possible between two bunches of bait, so as not to injure the bird when the nets are drawn over. Call-birds may be placed round about.



Clap Nets set for use

The various Wild Birds Protection Acts have greatly affected the business of bird-catching. The pole trap has been made altogether illegal, and a close time has been established, during which no bird-catching may proceed, except by the express authority of the owner or occupier of the land. But a large number of birds are included in a schedule whereby they are accorded protection from the owners or occupiers as well as from the general public. The original close time fixed by law was from the 1st March to the 1st August, but power was given to extend or alter this period according to the requirements in different counties; and also to give protection throughout the entire year to any species in which such a step appeared needful. The law regarding bird protection differs therefore to a considerable extent in different counties. In consequence of this protection, many birds, such as the goldfinch, which are much sought after by bird-catchers, have become far more plentiful in recent years.

[H. S. R. E.]

Bird Cherry. See CHERRY.

Birdlime.—This is an extremely sticky substance, by means of which small birds may be caught. It is usually prepared from the bark of the holly or mistletoe in the following way. Chop the bark finely and boil in water for several hours. Strain, and allow to ferment for some weeks, until a tenacious material makes its appearance. Some employ the gluten of wheat flour, obtained by placing the flour in a muslin bag and washing away the starch under a tap. Birdlime, when used, is smeared on twigs or wire netting in places frequented by the birds desired. A decoy-bird in a cage is sometimes used to attract the victims, *e.g.* a bullfinch will serve to allure its own kind.

[J. R. A. D.]

Birds.—Birds are so obviously different from all other backboned animals now existing, that a long description of their peculiarities is unnecessary, the possession of feathers, the modification of the fore limbs into wings, and the toothless beak being quite enough to mark them off from other groups. We know, however, that their remote ancestors were reptiles, and the oldest discovered fossil birds possessed teeth, while one of them had a long jointed tail like a lizard.

STRUCTURE. Some of the chief points in the structure of a bird are embodied in the accompanying figure, which represents a pigeon dissected from the side. A few words of explanation may be given of some of the words used.

Cere, a bare patch of skin near the nostrils. *Crop*, an expansion of the gullet, in which food is temporarily stored; *proventriculus*, first (chemical) part of the stomach, in which the food is subjected to the action of gastric juice, *gizzard*, second (mechanical) part of the stomach, serving as a mill and making up for the absence of teeth, *cloaca*, a chamber into which the intestine, kidneys, and reproductive organs open; *pancreas*, the 'sweetbread', from which a fluid that aids digestion passes into the small intestine through three tubes (ducts). *Glottis*, the opening of the windpipe. *Ureter*, the tube (duct) by which the kidney communicates with the cloaca. *Olfactory lobe*, *cerebral hemisphere*, *cerebellum*, *optic lobe*, and *medulla oblongata*, parts of the brain.

GREAT ACTIVITY.—The body of a bird is maintained at a very high temperature (about 103° F.), this being rendered possible by unusually effective breathing and circulatory organs. Loss of heat is prevented by the covering of feathers and the air which this entangles. This intensity of the vital processes is associated with that enormous activity which renders birds such potent friends or foes to the farmer, gardener, fruit grower, and forester.

YOUNG.—The young are either 'precocious', running directly from the nest, or helpless 'nestlings'.

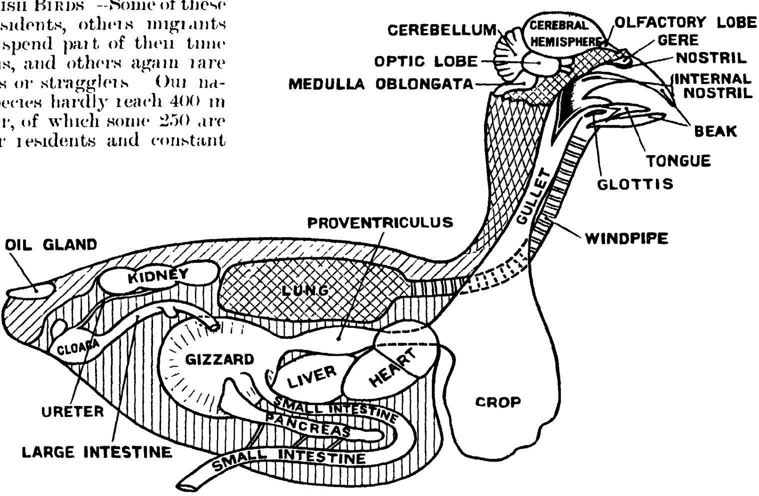
CLASSIFICATION OF BIRDS.—Existing species are arranged into two great groups—1, RUNNING

BIRDS (Ratitæ); 2, FLYING BIRDS (Carinatæ) The former includes the African ostrich, South American ostrich, the emeu and cassowaries of the Australian region, and the small kiwi of New Zealand. They have all lost the power of flight, and the breast bone is a broad curved plate.

In the FLYING BIRDS, to which all our native species belong, there are (with some few exceptions) well-marked powers of flight, and the powerful flying muscles, making up the flesh of the breast, are attached to a downwardly directed plate or 'keel' of the breast bone. It is scarcely necessary to say that the power of flight greatly enhances the usefulness or otherwise of these creatures, just as in the case of insects.

BRITISH BIRDS --Some of these are residents, others migrants which spend part of their time with us, and others again rare visitors or stragglers Our native species hardly reach 400 in number, of which some 250 are regular residents and constant migrants, while only about 60 are of any real importance to agriculture and the allied branches of industry.

THE PROBLEM TO BE SOLVED. — To decide whether a given bird is beneficial or harmful is no easy task, for the 'web of life' is infinitely complex, and our knowledge is very scanty. Extended and accurate information about the contents of birds' crops and stomachs at different times of year is badly needed, on the lines carried out in connection with American agriculture (by Hart Merriam, W. B. Barrows, and others), by Mr John Gilmour in Scotland, Professor Theobald at Wye College, and Mr. Collinge in the Department of Economic Biology in the University of Birmingham. There are, for instance, many birds, such as Fly-catchers, that feed entirely on insects, and at first sight we might be inclined to consider these as entirely beneficial. But such birds undoubtedly destroy many insects (*e.g.* ichneumon flies) which are actively engaged in keeping down the 'pests' belonging to their own class. We might naturally suppose, on the other hand, that birds which feed entirely on vegetable matter, such as Pigeons, are altogether harmful, but this would be a mistake, for many of them destroy a large number of weeds, though here a further complication arises from the fact that many seeds of such plants pass uninjured through their bodies and are thus distributed



General Structure of Pigeon

Further difficulties are met with when we deal with omnivorous birds, such as Rooks, in which the food is of mixed character. Even such a notorious offender as the house sparrow feeds its helpless young on insects, and thus does a certain amount of good.

We must also remember that the feeding habits of birds (apart from the question of young) differ in different places and at different times, while in some cases a gradual change of habits has been detected. Added to which some forms, *e.g.* the blackbird, which are very deleterious to the fruit-grower, may be beneficial to the farmer, and so on.

IDENTIFICATION OF BIRDS.—It is clearly important to distinguish between friends and foes, and not to ruthlessly destroy all small birds because a few are known to be harmful. For this purpose it would be well to consult some special book, such as W. J. Gordon's Our Country's Birds and How to Know Them. A number of leaflets on certain important forms may be had for the asking, from 'The Secretary, Board of Agriculture and Fisheries, 4 Whitehall Place, London, S W.', and letters of application need not be stamped.

DESTRUCTION OF BIRDS. — Refer to articles BIRD-CATCHING and BIRDLIME in this work.

TABLE OF CHIEF BRITISH BIRDS —The following table embodies a summary of the chief native species which are of more or less importance. The following abbreviations are employed.—B, beneficial to a large extent; *b*, beneficial to a small extent; H, harmful to a large extent; *h*, to a small extent; ?, doubtful case. Birds not mentioned may safely be left alone, and where a doubt exists the supposed offender should reap the benefit. But, on the other hand, if good and evil are equally balanced, and the former is of a kind (*e.g.* destruction of some weeds) which the farmer can easily and cheaply effect for himself, the verdict must be adverse to the bird in question.

ORDER	AGRICULTURAL VALUE	EXAMPLES
I. Game Birds (Galliformes)	B and *h*	Grouse, Ptarmigan, Capercailzie, Pheasant, Partridge, Domesticated Fowl, Guinea-fowl, Turkey.
II. Pigeons and Doves (Columbiformes) ..	*b* and H	Stock-dove, Turtle-dove, Wood Pigeon
III. Rails (Ralliformes).	B	Corncrake.
IV Gulls (Lariformes). .	B and *h*	Common Gull, Herring Gull, Brown-headed Gull, Lesser Blackback Gull, Greater Black-back Gull.
V Plovers (Charadriiformes) ..	B or *b*	Curlews, Godwits, Golden Plover, Lapwing, Ruff, Sandpipers, Snipe
VI Herons (Ardeiformes)	*b*	Grey Heron
VII Ducks and Geese (Anseriformes) .	*h*	Wild and domesticated species of Duck and Goose
VIII. Birds of Prey (Accipitres)	Mostly B and *h*	Falcon, Sparrow-hawk.
IX Owls (Strigiformes)	B	Barn Owl, Long-eared Owl, Short-eared Owl, Tawny Owl
X Goatsuckers and Swifts (Coraciiformes)	B	Goatsucker (Nightjar), Swift.
XI Cuckoos (Cuculiformes)	B and *h*	Cuckoo.
XII. Woodpeckers (Piciformes)	B	
XIII Perching Birds (Passeriformes) —		
1. Crows	Various	Common Crow (*b* and *h*), Hooded Crow (*b* and H), Jackdaw (B and *h*), Jay (B and *h*), Magpie (?), Rook (? B and *h*)
2. Starlings.	B for farmer, *b* and H for fruit grower	Starling.
3 Finches .	Various	Bullfinch (H), Chaffinch (*b* and *h*), Goldfinch (*b*), Greenfinch (*b* and H), Hawfinch (*b* and H), House Sparrow (*b* and H), Linnet (*b* and *h*)
4 Buntings	*b*	Yellow Hammer, Corn Bunting.
5. Larks .	B and *h*	Skylark
6. Wagtails and Pipits	*b*	Pied Wagtail, Yellow Wagtail, Meadow Pipit (Titlark)
7. Creepers	B	Tree-creeper.
8. Nuthatches	*b*	Nuthatch
9. Tits .	B	Blue Tit, Great Tit.
10. Thrushes	Mostly *b* and H to gardener and fruit grower, B and *h* to farmer	Blackbird, Chats (B), Fieldfare (B), Robin (B), Missel Thrush, Song Thrush
11. Warblers	Mostly *b* and H to gardener and fruit grower, *b* to farmer	Blackcap, Garden Warbler, Hedge Sparrow (*b* and *h*), Whitethroat
12 Wrens	B and *h*	Wren
13. Flycatchers	B	Spotted Flycatcher
14 Swallows	B or *b*	Swallow (B), House Martin (*b*), Sand Martin (*b*).

[J. R. A. D.]

Birds, Protection of Wild. — Several Acts of Parliament have been passed for the protection of wild birds. The first is the Wild Birds Protection Act, 1880 (43 & 44 Vic. c. 35), which, by section 3, imposes a penalty on shooting or taking of wild birds between 1st March and 1st August in any year. In the case of any wild bird included in the Schedule to this Act the penalty is not to exceed £1, and in the case of any other wild bird the offender is to be reprimanded and discharged on payment of costs for the first offence, and is to be liable to pay a fine of 5*s.* for every subsequent offence. The section is not to apply to the owner or occupier of any land, or to any person authorized by the owner or occupier of any land killing or taking any wild bird on such land not included in the Schedule. By section 4, where any person is found offending against the Act, and refuses to give his real name or place of abode, or gives an untrue name or place of abode to any person requiring him to give his Christian name, surname, and place of abode, he is liable to an additional penalty not exceeding 10*s.* One of the principal Secretaries of State as to Great Britain, or the Lord-Lieutenant as to Ireland, may, upon the application of any county council, extend or vary the time during which the killing and taking of wild birds or any of them is prohibited by the Act. The order is to be published in the London Gazette, or, if made by the Lord-Lieutenant, in the Dublin Gazette (s. 8). The operation of the Act is not to extend to the island of St. Kilda, and it is lawful for one of the principal Secretaries of State as to Great Britain, and for the Lord-Lieutenant as to Ireland, when it shall appear desirable, from time to time upon the application of the county council in any county to exempt any such county or part or parts thereof as to all or any wild birds from the operation of the Act. Any such order is to be published in manner provided in the preceding section. The Schedule names the following birds:—American quail, auk, avocet, bee-eater, bittern, bonxie, chough, colin, Cornish coulterneb, cuckoo, curlew, diver, dotterel, dunbird, dunlin, eider duck, fern-owl, fulmar, gannet, goatsucker, godwit, goldfinch, grebe, greenshank, guillemot, gull (except blackback gull), hoopoe, kingfisher, kittiwake, lapwing, loon, mallard, marrot, merganser, murre, nighthawk, nightingale, nightjar, oriole, owl, ox-bird, oyster catcher, peewit, petrel, phalarope, plover, ploverspage, pochard, puffin, purre, razorbill, redshank, reeve or ruff, roller, sanderling, sandpiper, scout, sealark, seamew, sea parrot, sea swallow, shearwater, shelldrake, shoveller, skua, smew, snipe, solan goose, spoonbill, stint, stone curlew, stonehatch, summer snipe, tarrock, teal, tern, thickknee, tystey, whaup, whimbrel, widgeon, wild duck, willock, woodcock, woodpecker.

By the Wild Birds Protection Act, 1881 (41 & 45 Vic. c. 51, s 1), the Act of 1880 is not to extend to a person exposing or offering for sale, &c., any wild bird recently killed if he satisfies the court that the killing of such wild bird was lawful at the time when, and by the person by whom it was killed, or that it was killed in some place to which the Act does not extend By section 2, the Schedule of the Act of 1880 is extended to include the lark.

By the Wild Birds Protection Act, 1894 (57 & 58 Vic c 24, s. 2), a Secretary of State may, upon application by a county council (or grand jury in Ireland), prohibit the taking or destroying of wild birds' eggs in any year in any place or places within the county, or the taking or destroying the eggs of any specified kind of wild birds within the county or part thereof. By section 3 a Secretary of State may, on the representation of a county council, order that the Act of 1880 shall apply within that county, or any part or parts thereof, to any species of wild bird not included in the Schedule of that Act Any order under this Act must be published in the county to which it applies during three weeks preceding the commencement of the period of the year during which it operates (s. 4). Section 5 provides a penalty not exceeding £1 for every egg taken or destroyed unlawfully (s. 5). The Act applies to Scotland, with the substitution of the Secretary for Scotland for a Secretary of State, and to Ireland, with the substitution of the Lord-Lieutenant in like manner.

By the Wild Birds Protection Act, 1896 (59 & 60 Vic. c. 56, s. 1), the powers exerciseable by the Secretary of State on application under section 8 of the Wild Birds Protection Act, 1880, are extended to the making of an order prohibiting the taking or killing of particular kinds of wild birds during the whole or any part of that period of the year to which the protection of wild birds under that Act does not extend, or the taking or killing of all wild birds in particular places during the whole or any part of that period. By section 4, when any person is convicted of any offence against the Act the court may, in addition to any penalty, order any trap, net, snare, or decoy bird used by such person to be forfeited. This Act does not extend to Ireland (s. 6).

By the Wild Birds Protection Act, 1904 (4 Edw. VII, c. 4, s. 1), every person who, on any pole, tree, or cairn of stones or earth, affixes, places, or sets any spring, trap, gin, or other similar instrument calculated to cause bodily injury to any wild bird coming in contact therewith, and every person knowingly permitting or suffering or causing any such trap to be so affixed, placed, or set, is made liable to a penalty not exceeding 40s. in the first offence, and for a subsequent offence to a penalty not exceeding £5.

Many orders have been made on the application of county councils under the powers conferred by the above Acts In order to ascertain what orders may be in force in respect of any particular district, application should be made to the county authority for the district

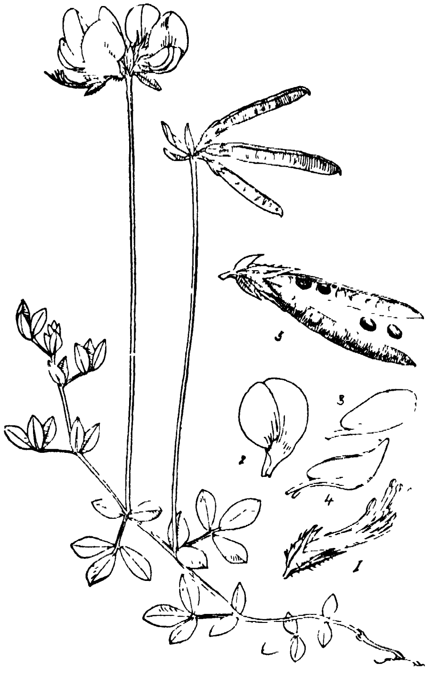
The Sand Grouse Protection Act, 1888 (51 & 52 Vic c. 55), provides a penalty not exceeding £1 for killing, wounding, or taking any sand grouse from 1st Feb 1889 to 1st Jan. 1892. This Act has since been renewed from year to year

Apart from the above Acts of Parliament and the Acts relating to game, wild birds being *feræ naturæ* at common law may be killed or taken by anyone There is no property in them before they are killed or taken. [A. J. S.]

Bird's-foot Trefoil (*Lotus corniculatus*) —This plant belongs to the nat. ord. Leguminosæ, and deserves more attention than has hitherto been given to it by our agriculturists. The plant is much esteemed in Switzerland, and Dr Stebler gives a complete account of it, from an agricultural point of view, in his Best Forage Plants.

Bird's-foot Trefoil thrives on almost any kind of soil; dry land, though poor, and at high elevations, suits it remarkably well, and on such land this trefoil is more productive than any other leguminous plant. It is a tap-rooted perennial herb with a short stock, which sends up branches from 6 in. to 2 ft. in height. The leaves on these branches enable us at once to distinguish it from all other leguminous plants —there are five leaflets per leaf, three leaflets together at the apex of the leaf, and two leaflets together at the base of the leaf. We thus see that this trefoil is no trefoil at all, for there are five leaflets per leaf, not three as in a genuine trefoil. Special branches from the leafy shoots bear umbels of yellow flowers, and each umbel of flowers when ripe becomes a thing like a bird's foot, composed of a number of cylindrical pods containing the seeds. The plant is at its best in the second year of growth. In spring, it shoots at the same time as Red Clover, and by the beginning of June the flowering stage is reached. It yields little aftermath.

Our opinion of the value of Bird's-foot Trefoil is liable to be wrong, if we judge by outward appearances only. It is certain that stock refuse to eat the plant in full bloom, and probably for the reason that the yellow pigment in the flower is very disagreeable. But if we examine our plants before the flowering stage is reached, we find that then the Bird's-foot Trefoil has been freely taken.



Bird's-foot Trefoil (*Lotus corniculatus*)

1, Calyx, stamens, and pistil 2, Standard 3, Wing 4, Keel 5, Fruit

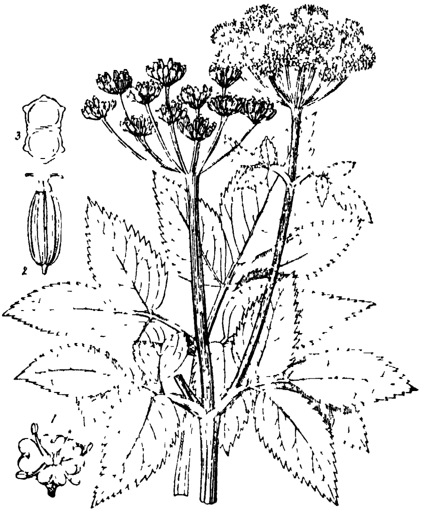
On soils which refuse to bear Red Clover, Bird's-foot Trefoil is worth a trial. One precaution, however, must be taken: we must be sure that the seed is from *Lotus corniculatus*, and not from the worthless *Lotus uliginosus* or Marsh Bird's-foot Trefoil. Only large shining brown seeds are genuine; the small olive seeds belong to the Marsh Trefoil. The rate of seeding is about one-third less than for Red Clover. The appropriate function of Bird's-foot Trefoil is to form permanent leguminous herbage in grass mixtures on soils that refuse Red Clover, and for this purpose 1 or 2 lb. of the trefoil may be incorporated in the seed mixture for an acre. [A. N. M'A.]

Bird's Nest, a popular name for the wild carrot. See Wild Carrot.

Bishoping.—The fraudulent alteration of tooth marks, in order to make horses appear younger than they are, has long been known by the foregoing term, as a man of the name of Bishop gained great notoriety by the practice. The long teeth of aged horses are reduced by chisel and rasp, and a groove made in the tooth table, and filled in with a black composition to resemble the natural infundibulum. This may easily deceive the novice. Even he may be put on his guard against the fraud if he will examine the upper incisors, which the dental artist will not be likely to have interfered with. See Age of Animals. [H. L.]

Bishop's Pine. See Pine.

Bishop's Weed (*Ægopodium Podagraria*). This very common Umbelliferous weed has extensively creeping underground stems, and is easily recognized by its large leaf-blades, which are twice ternate, each leaflet of a trio being egg-shaped. In shady ground under hedges, and in ill-kept garden or neglected arable land, the plant is well entitled to its name Masterwort, for it takes complete possession and smothers out all vegetation other than its own. The name Gout Weed, as also the specific name *Podagraria*, refers to its supposed efficacy as a remedy for gout. [A. N. M'A.]



Bishop's Weed (*Ægopodium Podagraria*)

1, Flower 2, Fruit 3, Cross section of fruit

Bison.—Properly speaking, the term Bison should be restricted to the two existing species of wild cattle of the genus Bos, which are distinguished from the rest of their allies by a thick and woolly coat, forming on the shoulder, neck, throat, and head a distinct mane, especially well developed in the bulls; by short, wide-set, smooth, curled cylindrical horns, by coloration of a uniform chocolate brown, varying seasonally in intensity, and by stature exceeding that of every member of the genus, except only the Gour (*B. gaurus*) of India, commonly but erroneously termed 'bison' by Indian sportsmen. The two species possessing the abovementioned distinctive features are sometimes referred to the genus Bison by naturalists, who split the genus Bos into several genera The better known of the two species is the American Bison (*Bos americanus*), usually but wrongly called Buffalo in the United States and Canada. Formerly this species, represented by many millions of individuals, extended from the Atlantic coast of North America westwards into Idaho and Utah, and from the region of the Great Slave Lake in the north to the northern parts of Mexico in the south, adapting itself equally well to forest and plain, and to latitudes where the heat of summer and the cold of winter were extreme. In spite of considerable persecution from both white men and Indians, it seems that no very marked diminution in the numbers of this animal took place in the first half of the 19th century, and that it was not until after the building of the trans continental railway in 1867, which severed the vast herd in two, that the process of extermination began in earnest. Thereafter it progressed with such speed that the southern herd was practically annihilated by 1875, while ten years later the northern herd was reduced to a comparatively small number of individuals To save this remnant from extinction, stringent preservative measures were put in force, and at the present time there is a herd of about 300 animals in Athabasca, Canada, and about a score are enclosed in the Yellowstone Park. In addition to these, some hundreds of specimens are kept in private parks, reserves, and zoological gardens in Europe and America Mr Hornaday's census of Jan 1, 1908, puts the total number of known American bison at about 2050, and since the Bison thrives and breeds in captivity there is no reason to think that the progeny of the existing stock will die out for many years to come.

The pairing season is in the late summer and early autumn, and the cows, which reach maturity in about three years, carry their calves nine months. A good-sized bull stands about 5 ft 6 in at the withers, though this height is sometimes exceeded; and the weight is between 1700 and 1800 lb. Cows are much smaller. The head is large and carried low; the quarters are weak and sloping; the legs are short, and the tail short and tufted. In America two local races of the Bison are distinguished one is the typical Bison of the prairies, and the other the Wood Bison (*B. americanus athabascæ*), which inhabits the area to the west of Smith's Landing, on the Athabasca River in Canada.

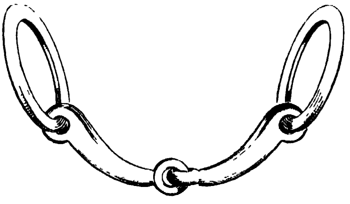
American Bison breed freely with domestic cattle; and experiments in producing these hybrids, called Cattaloes, are being carried out on an extensive scale to the west of the Grand Cañon of Colorado.

The second species of Bison, the *zubre* of the Russians, commonly called the European Bison (*Bos bonassus*), and frequently misnamed the Aurochs, still lingers under the strict protection of the Czar in the forest of Bielowitz, in Lithuania. There is also a herd preserved by the Prince of Pless in Silesia, and a few individuals are kept on the estates of Count Potocki in Volhynia, of the Duke of Bedford at Woburn, and in the various zoological gardens of Europe and America. Were it not for the protection afforded to this species it would long since have been exterminated by man, but although between 1860 and 1890 the number of preserved specimens was greatly reduced, a recent census taken in 1906 showed a substantial increase, the total number of captive and semi-wild specimens being computed at about 1500. As is attested by fossil remains, this species was formerly ve widely distributed in Central Europe and Asi its bones having been found in pleistocene deposits of England, France, Germany, and Siberia, while there is proof that it extended even to the Alaskan coasts of North America. Yet as a strictly wild animal it is now found only in certain districts on the northern slopes of the Caucasus, where it ranges in detached herds, consisting of from three or four to a dozen or so individuals, up to an altitude of about 8000 ft. There is no reason to suppose that it ever associated in vast herds, like its American ally, and unlike that animal, which particularly affects open prairie land, it is essentially a forest dweller, and is not met with in the open plains of South Russia Although carrying less abundant mane than the American Bison, the European species is a finer and less clumsily built animal, the legs being noticeably longer and the quarters higher The horns, too, are usually longer, and the tail is more hairy throughout its length. Except in the hairiness of the tail, this Bison is more nearly allied to typical members of the genus Bos than is *Bos americanus* The new summer coat is a rich dark-brown This gradually fades to light-brown in the winter and spring before being shed.

The name Aurochs, sometimes applied to this species, belongs properly speaking to the now extinct animal *Bos primigenius*, which formerly inhabited Europe, and was the parent stock of European domestic cattle [R. I. P]

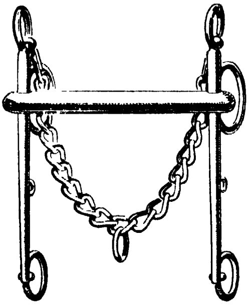
Bistort or **Snakeweed** (*Polygonum Bistorta*) - This is a perennial herb with a woody, twisted, underground stem, which belongs to the same nat ord. as Dock and Buckwheat, namely Polygonaceæ. It often occurs on the borders of fields, and as large circular patches in meadows. The larger leaves are down at the ground, are remarkable by reason of their long winged footstalks, and have blades from 3 to 6 in long. The pink flowers are arranged in spikelike racemes about 2 in. long In the north of England the plant is called Easter Giant, and about Manchester Patience Dock. The underground stem or rhizome was formerly much in repute for medicinal purposes [A N. M'A.]

Bit.- The comfort of the horse and of the rider or driver depends largely upon the selection and adjustment of a bit suited to the temperament and disposition of the animal. It is a fact universally recognized by horsemen that the hands of the rider or driver have almost as much to do with it. The animal which one man cannot restrain with a plain and easy bit nor with a powerful lever, will prove tractable enough with either in the hands of a man with that sympathetic touch or manner of holding the bridle or driving-reins which has long since acquired the term of 'hands'. A heavy-fisted individual is spoken of as having 'no hands', and one with just the kind of control needed as having 'good hands'. To get the best out of a riding-horse, one needs both 'hands' and 'seat'. Horses differ very greatly in their degree of sensibility in the mouth and in their tempers; hence it follows that individuals will behave quite differently when unsuitably bitted. One will 'fight' a punishing bit, while another will refuse to 'go into his bridle'. Another will throw up his head or shake it; or if one side or angle of the mouth is more sensitive than the other, will carry his head to the tender side, and thus acquire a most objectionable habit of so progressing. Some horses whose mouths have been spoiled in breaking (see Breaking) are so callous or insensitive at the angles, that a powerful lever, acting by means of a curb chain under the chin, is the only possible bit for restraining them in traffic, where their habit of 'boring' may lead to collisions, and in riding-horses to falls and other misfortunes to the rider. Although it may be said that the majority of horses can be so bitted as to be comfortable themselves and kept under perfect control by the rider or driver, there is an art in ascertaining the most suitable equipment which can only be acquired by experience, and beginners will do well to consult an expert horseman. In the making of a 'mouth', the breaker will choose a key bit, which is a bar with a number of keys (see Breaking), and from this will teach the colt to go in a plain snaffle. A plain, smooth bar or a jointed snaffle may be preferred after trial, but the first principle of bitting is to use the easiest, lightest, smoothest bit that will sufficiently restrain and guide the animal; nothing being so much prized in the hunter and hack as a 'light' mouth, or one quickly responsive to the slightest indication of the rider. The finished horseman generally prefers a harness horse with a delicate mouth, but this is not a universal demand, some choosing a horse that 'takes hold' and is seemingly under better control, while not fatiguing the driver by pulling. All sorts of bits are therefore required, and much ingenuity has been exercised in providing bits for all sorts of mouths and temperaments.

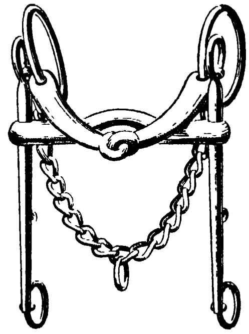


Plain and Easy Snaffle

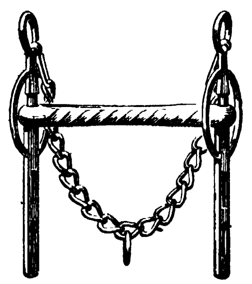
There are some eight varieties of snaffle bits, besides the straight bar with a ring at each end. Of these, the chief are the plain, the twisted snaffle, the chain snaffle, the double-jointed snaffle, the double-ring snaffle, and the gag snaffle. These offer varying degrees of restraint, and among them can generally be found one to suit. It happens occasionally that a mouth is so extremely sensitive that when all other methods have failed, a plain snaffle covered with rubber or leather will answer the purpose. Single- or double-reined bridles may be used with snaffle bits, but the bridles in general use combine both the snaffle and curb, when two reins are essential. This combination is found advantageous because under ordinary circumstances, as on the road or in riding to the meet, the bridoon or snaffle bit will exercise all the governance needed, but in the heat of the chase the curb will be required. The horseman rides 'on' the snaffle as it is called—that is to say he governs the animal with the light bit, and allows the curb rein to hang slack until required, thereby saving the horse inconvenience, and avoiding that hardening of the mouth which will sooner or later spoil the best of mouths.



Pelham Bit



Double Bridle, The Weymouth



Liverpool Bit

The curb bit is a lever in which the inside of the mouth is the fulcrum, and the increased power is brought to bear on the chin by means of the chain; the degree of leverage depending on the length of the bars, but the principle being the same always. There are bits, like the Pelham, in which the rein may be buckled in the ring against the angle of the mouth, and always spoken of as the 'cheek', or at the end, whereby much greater power is gained. This plain Pelham is a generally esteemed bit; but there is a severer one with two joints in the mouthpiece, united by a high port, and the sides of the mouthpiece are covered with rollers similar to those in the guard bit. Harness horses kept for display and required to wear a bearing-rein, have a bridoon or snaffle and a curb bit as well. A great variety of these are sold, but, as we have already said, the principle of the lever is always the essence of the control. The most popular of all harness bits is the Liverpool, with a bar plain on one side, ribbed on the other, and offering four degrees of power. The lightest is that in which the rein is buckled over the bar immediately in front of the mouthpiece; the next, in which the 'cheek' ring is used; then the 'middle bar', and lastly the 'bottom bar', as they are universally spoken of by horsemen. The chain under the chin is governed by the usual strap when needed. Heavy draught horses are nearly always bitted with a jointed snaffle of large size; but there are, of course, individuals not possessed of the placid temperament which characterizes the type, and needing one or other of the contrivances referred to for harness horses of the lighter and more active breeds.

Whatever bit is chosen, it should fit the animal as to size and width, and should be attached to the bridle in such a manner as to hang free in the mouth, immediately below the angles, and not pressing against them when the reins hang loose. [H L.]

Bites and Stings.—In this country we are accustomed only to think of insects as offenders in the matter of bites and stings, and seldom indeed are we called upon to treat the more serious injuries inflicted by venomous reptiles. Adders in some districts are numerous, and when a beast or sheep lies down upon them they will inflict a bite which will cause serious illness if not death. The large udder of the cow, with its soft skin, invites retaliation on the part of the adder when unintentionally injured by the animal.

The symptoms are those of coma, the bitten animal seeming to be mentally paralysed, and generally inert, with dull and expressionless face, and drooping ears, cold extremities, shallow breathing, suspended rumination, and suppressed lactation. If the cause is suspected, and the udder carefully examined, a dark mark may very likely be found where the bite was inflicted. Its appearance is in shape like what is known as leech bite, or a splitting of the skin in stellate form, rather than a direct puncture such as might be caused by the tooth of a quadruped of any kind. A blue or purple area of varying dimensions marks the bite of the adder, which portion is insensible to the touch, while the rest of the organ will be inflamed and swollen.

Treatment.—The recommendation to cut out the bitten portion is not one to be advocated in these islands, although applicable to snake bite in other lands, provided always that it is soon enough detected. The illness of the beast is the first thing noticed, and it is then too late for surgical measures, other than the injection by hypodermic syringe of a very weak solution of ammonia. Large doses of sal volatile freely diluted, digitalis and brandy, or other alcoholic stimulants, may be given to rouse the patient, who must be tempted with a variety of food, and nursed through the period of depression, when no serious consequences will be left, if garget is not set up in the mammary gland (for treatment of this, see GARGET).

The bites and stings of insects are often of serious consequence on account of the maddening influence they have upon the victims; causing horses to detach their bridles and run away, or tear their eyes or mouths by harness hooks or gear, when passionately throwing their heads round in vain efforts to dislodge the enemy. Cattle and sheep are tormented, and their rest so broken as to hinder the processes of milk-making and fattening.

Whether the insect bites or stings his victim, the poison is of an acid character—formic acid in the case of bees and wasps—and is best neutralized by the application of an alkali. Liquid ammonia is preferred as an application because of its easy penetration through the hairy skin of an animal, but a solution of common washing soda, of bicarbonate, or of potash, will also have the desired effect. The popular belief in the blue-bag is an exaggerated one, its virtues are due to the alkali with which the blue is manufactured.

So long as a sting remains in a wound it continues to diffuse its poison, and rubbing the place is therefore the worse thing the victim can do. Every effort should be made to find and remove stings by means of forceps or tweezers. In the case of a horse stung about the head by a swarm of bees, his recovery will practically depend upon the celerity with which the stings are extracted. He may recover from the shock and the quantity of poison originally injected, but will not survive the additions which proceed from the rubbing above referred to.

A really reliable preventive or deterrent to flies settling on horses at work has not been discovered, but the nuisance is mitigated by sponging with a paraffin rag, or a wash in which this fluid has been mixed. It needs to be lightly applied to avoid irritating the skin, and repeated at frequent intervals, at the period of the year when flies are most numerous and persistent. A decoction of walnut leaves has some merit in this direction, but is not so lasting as paraffin, or any preparation of coal tar, as very dilute Jeyes' fluid. Infusions of quassia and tobacco are employed, and for limited areas, as the poll and around the eyes, essential oils of pennyroyal, of eucalyptus, or cloves, may be used. [H L.]

Bitter Milk, Butter, and Cheese.—Bitter milk is occasionally, though very rarely, due to foods eaten by the cows; thus lupine and ragweed have been stated to have been the cause of bitter milk. A bitter taste, though not usually pronounced, may occur in certain cases of disease of the udder, such as mastitis. If due to either of these causes, the bitter taste is apparent as soon as the milk is drawn and does not increase. Peptonized milk becomes bitter if the ferment is allowed to act too long.

Bitterness in milk is, however, more frequently due to bacterial fermentation, and several organisms have been described which cause a bitter taste to appear in milk. The most frequent occurrence of bitterness is due to a resistant spore-forming organism, which develops an intensely bitter taste in imperfectly sterilized milk or cream; it is fortunately not common, as the spores stand heating to boiling-point for a considerable length of time, and are not always destroyed by commercial processes of sterilizing milk. Another organism also occurs which causes a bitter taste in fresh milk, and an instance of this was studied by Conn, the taste developed in a few hours from milking, and in such cases the trouble becomes one of significance in the ordinary dairy; it is, however, so rare as not to be serious.

The occurrence of bitter butter is also exceedingly uncommon, and is due usually to the cream containing the bitter spore-bearing organisms having been pasteurized, with a consequent destruction of the ordinary bacteria. The use of a reliable starter, however, prevents its development.

Cheese is perhaps the most common dairy product to be attacked by bitterness. The organisms which produce a bitter taste in milk will also cause bitterness in cheese, and in addition organisms have been separated from bitter cheese which have not been connected with bitter milk; it is probable that, given favourable conditions, they would have affected the milk, but in cheese, which is ripened for long periods, slow-growing organisms are able to develop and exert their full effect, whereas the milk would have become sour and unfit for consumption before their effect would be noticed.

Such an organism, named *Micrococcus casei amari* by Freudenreich, is the most common cause of bitter cheese; it did not develop a bitter taste in milk until it was two days old, and when the milk was made into cheese the latter became very bitter.

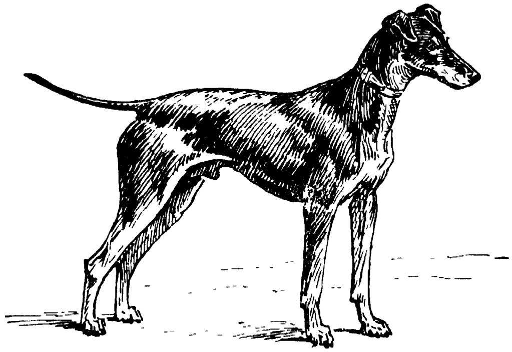
Bitterness in cheese in a number of cases in America was traced to a widely distributed yeast, which found its way into milk vessels that were left standing open by roadsides, under trees, or near barnyards. An efficient remedy for this was found to be greater cleanliness, increased care in handling the milk, and sterilizing the cans and utensils. [H. D. R.]

Bittersweet (*Solanum Dulcamara*). - In autumn one often sees in hedges and copses tempting-looking oval red berries about ½ in. long. These are the poisonous fruits of Bittersweet or Woody Nightshade. The plant belongs to the same family as the potato and tomato, namely Solanaceæ, and indeed to the same genus, namely Solanum. Our Bittersweet, however, is a woody plant, scrambling over hedges, and not a herb growing in the open field. The scrambling branches arise from an extensively creeping underground stem. The leaves are more or less heart-shaped, and the flowers are arranged in purple, drooping clusters opposite the leaves. [A. N. M'A.]

Bitter Vetch. See VETCHES.

Bixa Orellana, a shrub which is grown in Brazil and in the West Indies, and from which the colouring matter Annatto is derived. See ANNATTO.

Black-and-Tan Terrier.—Amongst the favourite dogs of the past which of recent years have fallen into disrepute through no fault of their own is the Black-and-Tan, sometimes, but quite erroneously, described as the Manchester Terrier. The variety is unquestionably a descendant of the old English breed of terrier which existed many years ago, and which has proved the basis of several popular varieties of the present day, but, as may readily be surmised, the Black-and-Tan with his exquisite colouring and fancy markings has been very carefully developed by his admirers in the past. Quite possibly the breed began to lose favour with the public when the edict against cropping ears was passed, as the Black-and-Tan was a regular victim of the practice; but in addition to the difficulty that was experienced in breeding him, this terrier is rather a delicate animal to rear, and besides this, as his courage is not of the very highest order, he is comparatively useless as a vermin dog. Hence it is only natural that he should have lost favour with the public as other varieties became better known; but still the practical extinction of an old English breed cannot but be deplored when the support that is accorded to foreign varieties, many of which are perfectly useless, is taken into consideration.



Black and Tan Terrier

The skull of the Black-and-Tan Terrier is flat at the top, of considerable length for the size of the dog, the muzzle being likewise long, and tapering gradually towards the nose, which should be jet-black. The teeth must be level, an irregular under jaw being a decided fault, and the eyes as black as sloes, very small, and of the almond rather than the round shape. There must be no approach to any bumps or irregularities of the surface of the cheeks at the base of the jaws; the ears must be small and hang with their tips turned forward, so as to protect the inside; the neck is rather long, the shoulders sloping, and the back short and level. The body may, in fact, be described as being 'cobby' in appearance, and the front legs must be of a good length and quite straight, with no tendency to turn out at the elbow, the hind ones being rather bent at the stifles, and the tail short, fine, and carried quite straight, without any tendency to curl. The coat is short and rather fine to the touch, but the greatest point of all to be secured, provided that the head properties are correct, is that of the colour. This should be a rich raven black all over, excepting at the following points, which should be of a bright tan hue of a rather deep shade. Those tan markings appear on the feet, which should be tanned up to the pasterns, with black pencillings running up each toe. There is a spot termed the thumb mark at the pastern, whilst the lower part of the muzzle and the throat are tan, and there is a spot over each eye and on each cheek, the vent and insides of the hind legs being also tanned. If hairs of the latter colour appear anywhere else it is a decided fault, but they often do so to the injury of the dog's value, and generally just behind the ears and on the thighs. These places should therefore be carefully examined to ascertain whether any tan-coloured hairs are to be found amongst the black ones, or if a dishonest vendor has stained the coat in order to conceal the blemishes. The tail should also be pushed down to discover whether there is too much tan on the vent, which there will be if the tail does not conceal all there is from view. As regards weight, it may be added that a good specimen will weigh about 18 or 20 lb. [V. S.]

Black Beetle. See Stilopyza.

Black Bent, a name for the Slender Foxtail (*Alopecurus agrestis*). See Alopecurus.

Blackberry. See Rubus.

Black Bindweed. See Bindweeds.

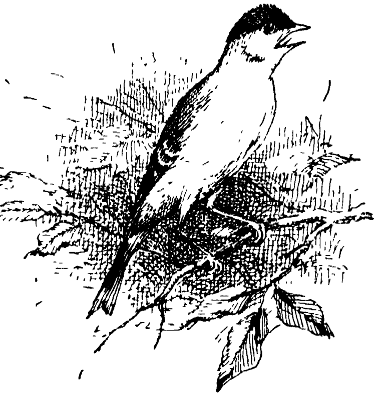
Blackbird (*Turdus merula*).—This handsome member of the Thrush family is too well known to need a detailed description, but it may be noted that the epithet 'black' only applies to the male, which is further distinguished by his bright-yellow bill, while the female is brown both as to plumage and bill. The species is a constant resident, though its numbers are greatly augmented every year by the arrival of large flocks in the eastern counties. The nest is built of twigs and roots, in shrubs or hedges not far from the ground, plastered with mud, and lined with grass and moss. The eggs are four to seven in number, with light-brown frecklings on a greenish-grey ground.

This is one of our native birds which is increasing rapidly in numbers, partly owing to the immigration mentioned, and partly because under favourable conditions it rears three or four broods every year. There are many complaints from fruit-growing districts in several counties regarding the difficulty of keeping its numbers down. This may be realized by considering the figures given by Prof. Theobald of three of the East Kent Sparrow and Rat Clubs (Elmsted, High Halden, and Wye) for 1906. Although these accounted respectively for 469, 291, and 700 blackbirds, there has been no marked diminution.

Food.—Some authorities, as Ritzema Bos, describe this as consisting largely of insects and snails, and it is so far beneficial. But all agree that the Blackbird is fond of fruit, and it is a veritable pest to the fruit-grower, destroying vast quantities of such fruits as currants, cherries, plums, raspberries, and strawberries, and in some places attacking apples. It also does some harm by destroying small singing birds of beneficial kind.

So far as the farmer whose interests lie in ordinary crops or stock, the forester, and the gamekeeper are concerned, the Blackbird would appear to be beneficial in so far as it destroys insects and the like, though the extent of the benefit is doubtful. But the gardener and fruit grower are fully justified in keeping down its numbers by every means in their power. How far those who are not affected by its ravages should nevertheless persecute the Blackbird for the sake of their neighbours is another question. Few would desire the utter extinction of the species, but of this, in any case, there appears to be little chance. [J. R. A. D.]

Blackcap (*Sylvia atricapilla*).—This beautiful little member of the Warbler family, which receives its name from the black 'cap' on the head of the male (brown in the female), is a resident and summer migrant. It is one of our most gifted songsters. The nest is slightly but neatly built of grass, roots, and other plant material with a little hair, in bushes or hedges near the ground. The four to six eggs are light-brown, with brown-blue spots.



Blackcap (*Sylvia atricapilla*)

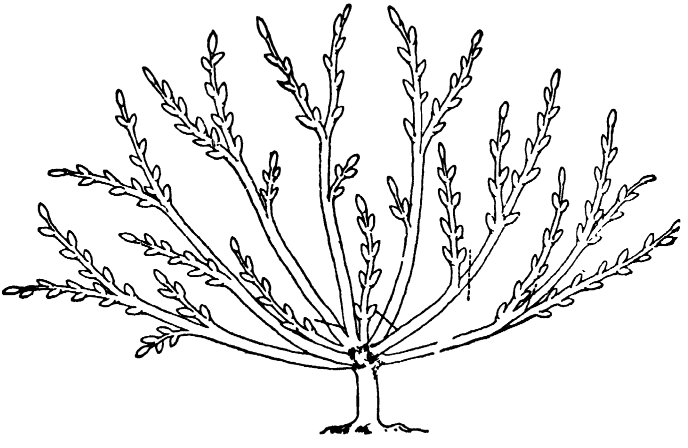
Food.—There is here some dearth of information, but Ritzema Bos says that it consists of insects during the summer, and the young are chiefly fed on flies, gnats, and smooth caterpillars. On the other hand, it must be admitted that the Blackcap is fond of fruit, attacking cherries, currants, raspberries, and strawberries, and opening peapods.

To the farmer and forester the bird is undoubtedly beneficial, but gardeners and fruit growers are justified in keeping down its numbers, though even upon them it confers some benefit. [J. R. A. D.]

Black Colour. See Colour in Animals.

Black Currant Gall Mite. See Eriophyes ribis.

Black Currants. — The Black Currant (*Ribes nigrum*) grows wild in North Asia and North Europe, including the British Isles, although in the latter, according to Watson, it is an alien. The wild plant forms a stout, erect bush, with lobed, serrated leaves about 2 in. in diameter, which smell strongly when bruised. The flowers, which are green, are borne on slender racemes, and the berries are globose, ⅜ in. in diameter, and black. Under cultivation the fruit has been improved in size and flavour, and in the number borne on each raceme. Their powerful and peculiar odour is due to an oil contained in the skin, and it is to this that the fruit owes its reputed medicinal value, jelly made from the fruit being much recommended for sore throat. Jam and wine are also made from Black Currants, and they are in much request for tarts and puddings. The Black Currant has become important in some parts of France, where the fruit is made into a pulp for use in confectionery. Over 1000 tons of this pulp are made annually in the Côte d'Or, and about one-half of this is sent to Britain. The pulp is prepared as follows. The currants are stripped from the stalks and put into copper pans with water, then heated to boiling-point, and at once placed into tins and carefully soldered up. These are boiled for twenty minutes, after which they are ready for the packer. The price of the pulp in this country is about 30*s.* per cwt.



Winter Pruning of Black Currants

Among bush fruits cultivated in gardens and orchards for home use the Black Currant is one of the most popular, growing as it does in any garden soil under ordinary conditions, and, when it can be kept free of mite, it rarely fails to yield a satisfactory crop. This mite (*Phytophus ribis*) first appeared about forty years ago, and it has since spread over the whole country, so that it is difficult to find now a garden where it is not present. Its presence is revealed by the swollen buds on the young branches, which become abortive, rarely developing either leaves or flowers. No simple remedy has yet been discovered, although several palliatives find favour with cultivators here and there. In small gardens where the bushes are not numerous, the best cure is to burn the affected bushes, and to start afresh with clean young ones. The prunings, which should be removed early, should always be collected and burned, and as a preventive of the spread of the mite, the bushes should be thoroughly sprayed with a mixture of 1 lb. lime, 1 lb. sulphur, and 20 gal. water, or they may be dusted over with a mixture of unslaked lime, 1 part, and flowers of sulphur, 2 parts, to be applied when the bushes are wet early in April, and again a fortnight later.

Black Currants may be grown either as bushes by themselves, in rows between fruit trees, such as apples and plums, or trained against walls with a north-west aspect, the distance apart in each case being from 5 ft. to 6 ft. They should be transplanted soon after the leaves have fallen, or at any time between November and February, plants two years old being quite large enough. The finest fruits are produced on the wood of the previous year, so that pruning should be confined to thinning out the old wood, and the removal of suckers (see the illustration). The shoots should never be spurred back as for Red Currants. Bushes trained against walls should be kept open, so that light and air are admitted to the shoots. The best fruits are produced by bushes trained on walls, and by reducing the number of bunches those left will develop much larger berries than when thinning is not practised. An annual mulching with well-rotted stable manure has a marked effect on the health and productiveness of Black Currants. In dry weather, especially where the soil is light and dries quickly, it pays to afford water frequently. The draining of manure heaps and stables may be used profitably, particularly during the fruit-forming period. Old bushes are not as a rule productive. It is therefore advisable, where a falling off in the quantity and the quality of the fruit is perceived, to replace the old with healthy young plants. Cuttings about 1 ft. long, taken in autumn after the fall of the leaf, formed of the firm young branches, from which the lower buds have been removed, should be inserted in rows, 6 in. apart, setting them 6 in. deep. They will start growing the following spring, and in the autumn will be ready for transplanting. It should be mentioned that Black Currants prefer slight shade and shelter from strong winds. They are not a success in high, exposed situations, where the soil is dry. The finest fruit is grown near the sea, where we have seen berries as large as ordinary grapes, produced by bushes growing in soil that was practically all sand, but fed liberally from the pig sty and stable. The varieties preferred by British growers are *Baldwin*, a heavy cropper; *Black Naples*, very large and good, one of the best, *Boskoop Giant*, said to be mite-proof, *Lee's Prolific*, an old favourite of excellent flavour; *Ogden's Black*, and *Carter's Champion*, which has long clusters of large, juicy, well-flavoured berries. [W. W.]

Black Dolphin, a name for the Collier or Bean Aphis. See APHIDES.

Blackface Sheep, Scotch Mountain.—The origin of the Blackface or Scotch Mountain breed of sheep is shrouded in mystery. Only one thing is certain: it has existed with more or less all its present characteristics for many centuries. Hector Boethius, writing about 1460, and speaking of the sheep in the vale of Esk, says 'Until the introduction of the Cheviots, the rough-woolled Blackfaced sheep alone were to be found'. Prof. Lowe in his work The Domesticated Animals of Great Britain (1842), says. 'The more northerly division of the chain of mountains beginning in the heathy lands of Yorkshire and Lancashire has given rise to a race of sheep now very widely diffused. This race has been termed the Blackfaced Heath Breed, a name which, though it does not distinguish it from some of the Forest breeds, may be retained as indicating its peculiar habitat in a country of heaths. It extends across the vales of Kendal and Eden to the higher mountains of Cumberland and Westmoreland on the west, and by the Carter Fell into Scotland, where it occupies the great range of the Greywacke hills stretching from St Abb's Head on the east to the Irish Channel on the west. It stretches through the upper part of Lanarkshire into Argyllshire and all through the Highlands of Scotland, from the Grampians to the Pentland Firth. It has spread to all the Hebrides, and even to the islands of Orkney and Zetland. This breed may be supposed to have found its way into Scotland by the mountains of the north of England. It has been settled for a period unknown in all the high lands of the counties of Roxburgh, Dumfries, Selkirk, Peebles, Lanark, and all the adjoining districts. The breed is said by some to resemble the Persian, so that it might be conjectured to have been derived from the East. But it is more natural to assume that its peculiar characters have been communicated to it by the effects of food and climate in the rough heathy districts from which it is derived.'

Whatever their origin may have been, so far as Scotland is concerned they appeared first in the south, gradually found their way north into Dumbartonshire, Perthshire, and the Western Highlands. There, by sheer aggressiveness, they displaced huge droves of cattle and the native breed of small whitefaced sheep, and, generally speaking, populated the whole district south of the counties of Ross and Sutherland.

It is very interesting to read of their introduction to the Highlands, where they were by no means universally welcomed. One admirer of the old native breed, which was noted for the fineness of its wool, in writing to the Highland Society in 1790, makes the following comment. 'The coarse-woolled sheep have been debasing the breed under the name of improving it, so that I am inclined to believe that on the mainland of Scotland the true unmixed breed is irrecoverably lost.'

In another passage the same writer gave it as his opinion that if the original breed existed anywhere entirely unmixed, it was in Shetland. A rather interesting account of this old breed is given by Marshall. He says 'Formerly, and I believe from time immemorial, the Highlands and the entire north of Scotland were stocked with a race of sheep almost as different from those of the southern provinces as goats and deer are from the ancient breed, whose fur consisted of a sort of down, overtopped by long, straight, rigid hair, somewhat like the coat of the beaver and other furred animals; widely different from the wool of European sheep in general. And besides this distinction of coat there is another characteristic difference which marks them still more strongly. The tail, which in all varieties of woolled sheep is long and all covered with rich wool, resembling that of the rest of the body, is, in the animal under notice, short, tapering, and thinly covered with strong silvery hairs, and not exceeding in size that of the goat or deer. Its face, too, is covered with sleek hairs as that of the deer, and like this, it has the eyes prominent.'

About the beginning and middle of last century a great proportion of the best Blackface grazings in Scotland had their stocks changed into Cheviots. It is very probable that, had the owners of these Cheviot flocks been content to work up the breed on the lines of Blackfaces, and to preserve above all things the points that make for hardiness, they would have come to stay; but such was not the case, and after a succession of bad winters and late springs the Blackfaces had in most cases to be restored to the grounds they should probably never have left. It is estimated that there are at present about 1,000,000 Blackface sheep fewer than there were twenty years ago. There are several reasons to account for this diminution, of which the most important is the vast extent of country cleared of sheep to form deer forests. The great advantage of light stocking has also become more widely recognized. While large numbers are found in every district of Scotland, the greatest Blackface sheep-raising counties are naturally Argyll, Inverness, and Perth. Blackface sheep are found all over England, and are kept as regular stocks in Northumberland, Cumberland, Yorkshire, and Lancashire.

The importance of Blackface sheep is incalculable. It seems certain that if something equally hardy is wanted to take their place, either deer or goats must be resorted to. Commercially, the substitution of goats would be retrogression, while in view of the expense and uncertainty connected with deer forests, the experience of those landowners who have adopted this course leads to the belief that the substitution of deer for sheep will be more rare in the future. In large measure this is due to the heavy loss involved in changing stock. In these circumstances the existence of a breed of sheep such as the Blackface must continue to be a boon to many proprietors, whose high mountain land would otherwise be of little value. Not only does this breed thrive and fatten on such land, but it is universally admitted that, owing to the character of the mountain herbage, the mutton is of exceptionally fine and sweet quality.

It is not many years since epicures insisted on three- and four-year old Blackface mutton as the greatest delicacy, and high prices were paid for sheep of nice medium weight. Fashion and the wool market have changed this. When wool brought high prices the fleece of the Blackface warranted the farmer in keeping his wethers till three or four years old. But in these times, when the fleece counts for little comparatively, the sheep must be turned into cash as soon as possible. Fashion clamours at the same time for young and tender mutton; so that as regards the Blackface there is a literalness in the saying that 'All flesh is as grass, which to-day is, and to-morrow is cast into the oven.' But while fashion asks for the younger mutton and good prices are obtained for it in the food market, the wool of the Blackface is still a valuable asset to the farmer or landowner, considering that it is grown by a breed which thrives on land otherwise of little value. To show how Blackface mutton is appreciated, it may be interesting to relate that some wether lambs sold at Lanark in autumn, 1906, were eventually killed and shipped in carcass form to New York. No doubt the millionaires who made the mutton the *pièce de résistance* at their Christmas dinners thoroughly enjoyed the fine flavour, which it is hoped was in no way impaired by the necessary cold storage. Before the passing of the three-year-old wether, the chief outlet for Blackface male lambs was the big wether farms which existed, chiefly in the Highlands. Very fortunately for breeders, about the time this road came to be barred the lambs began to be popular with feeders. The fact is realized that three Blackfaces can be kept as cheaply as two of a larger softer breed, and will leave as good a return per head, and the question 'What is to become of the wether lambs?' is solved. The fat ones are at once killed for the London, Manchester, Liverpool, and Birmingham dead-meat markets, where their nice size and quality make them prime favourites. The leaner ones are kept on and fed for the Christmas and spring sales of fat stock, and few varieties of sheep leave such handsome profits. The cross between the Blackface ewe and the Border Leicester, and Wensleydale, and to a less degree Shropshire Ram, is also popular among feeders. On many low-lying hill farms every ewe is crossed, and the Blackface mid ewe lambs find a ready market to keep up these stocks. On arable farms the custom is to buy cast ewes off the hills, and from them one cross lamb is taken, and both ewe and lamb are prepared for the butcher. On farms which produce fat lambs, or lambs which mature quickly, the Border Leicester and Shropshire Ram are used, while the Wensleydale is more in vogue where the lambs are inclined to be lean and growthy. The average weight of a five-year-old eild ewe or a three-year-old wether, off the hill, may be put at 48 to 52 lb. of dressed mutton. Until recently, Blackface sheep were never exhibited at fat-stock shows under two or three years of age, indeed they were thought not to have arrived at maturity sooner. Now, however, they are shown as shearlings, not only of superior quality, but of heavier weights than they could be produced at three years old twenty years ago. In 1899, at Smithfield, where they have always been a favourite breed, Mr. M'Dowall of Girdstingwood gained the championship of the show, among the long-woolled breeds, with a pen of three shearling wethers which scaled 673 lb. In 1902 Sir John Gilmour of Montrave won in the recently started class for wether lambs with a pen of three, weighing 461 lb.

The wool of the Blackface sheep is a unique product, and is now used almost entirely in spinning wools for the carpet trade. In bygone years a considerable portion was spun into yarns for making braids, and the best qualities were in particular demand for this purpose. Latterly, however, owing to the change that has taken place in the character of the fleeces now generally produced by flockmasters, the percentage of wool of a quality suitable has become so small that spinners of these yarns have almost given up its use. A very large proportion of the production now goes to the United States of America, where it is used entirely for the purposes of carpet manufacture. In this country it is used to some extent for clothing purposes; when the rougher tweeds are in fashion it is blended with other wools in the making of them. Only, however, the finer, softer, and shorter wools are at all suitable, the best adapted being got principally in the counties of Argyll and Inverness.

The weight of the fleeces varies in the different localities. The southern counties, including Perth and Stirling, produce the heaviest fleeces, the average weight being from 4 to 5½ lb., while the general run of clip per ewe in Argyll, Inverness, and Ross is from 3 to 4 lb. Probably the very heaviest fleeces are produced in Lanarkshire, Ayrshire, and Midlothian, but in them, owing to the nature of the grazings, a larger percentage of foreign matter is found, and frequently the shrinkage in cleaning these wools is from 5 to 7½ per cent above those that are cleaner grown. Hog fleeces may be taken to weigh 1 lb. more than ewe, and the average weight of three-year-old wether fleeces may be put at about 6 lb. All these figures are for *white* wool. The old fashion of smearing is still practised by a few Skye crofters, but any broker would have considerable difficulty in filling an order for a dozen bags of *laid* wool. The value of the wool has fluctuated greatly of recent years. In 1601 it fell to 4*d*. or 4½*d*, and in 1907 rose to as high as 8*d*. to 8½*d*. In 1908 a downward tendency again became evident, a drop of 3*d*. per lb. on the previous year's prices having been recorded.

It does not seem possible to grow the wool too strong if it be kept moderately free from kemp and black spots. To provide adequate protection for the sheep must be the first consideration, and a strong, thickly planted fleece, uniform all over the body, and one that will not readily open up to let in wind and rain, should be aimed at. A thin, long fleece causes the shepherd to grumble, as the sheep are thereby rendered helpless in snow and wet, and the lambs prevented from sucking. Over-roughness is blamed for causing tup-eild ewes, which are more common than in former times. A very usual practice is to clip the tails of the ewes, but if this course be adopted, care must be taken that it is not done too near the time when the rams are put out. Blackface hoggs are usually sent away for the winter, and return to their grazings in the beginning of April. They are clipped about the third week of June, when the lambs are marked. The clipping of the milk ewes takes place in July, the exact time depending on the character of the season and the nature of the farm. It is found that both hoggs and ewes have ample new wool grown by winter to keep them warm, and this fact points to the absurdity of the present custom of clipping the rams in January or earlier. It is generally believed that wintering the young rams in well-ventilated, airy houses does nothing to impair the constitution of the sheep, undoubtedly it is the cheapest method, as all waste of food by wind and rain is avoided. In order to ensure, however, that the sheep will be at his fittest when the ewes require his services, he ought not to be clipped till May or June. Clipping in early January means that the ram will have nearly a year's growth of wool to carry while he is out on the hill, and in wet weather the additional weight is a great drawback. In snow he gets completely matted up and is unable to move, the result being, of course, an unnecessary percentage of eild ewes. Most buyers, when they purchase an early clipped ram, shear him a second time before turning him out; but this must be wrong, as the sheep naturally requires more covering in winter than he has had in summer, and the effect of the second clipping is often a chill, attended not infrequently by fatal results. Excessive feeding in summer is also to be deprecated. It is not fair to expect a ram to do a heavy season under any but the most favourable circumstances, and the sudden stopping of the hand-feeding which he has been receiving all summer is most injurious. Of course, if the ram can be fed while he is with the ewes, the evil is mitigated, but in the great majority of cases this course is impracticable.

A good specimen of the Blackface Ram is a most majestic and picturesque animal. He has a fine carriage and appearance. He should have a broad, deep face, with a square muzzle, deep jaw, wide nostrils, and a wild, piercing eye. He should have a small tuft of fine wool on his forehead, called a 'snow lock', which betokens a good cover of wool below the body. The prevailing colour of his face and legs should be jet-black, and if marked with white, the two colours should be quite distinct. A pure black face is apt to be accompanied by a black 'turn up', but in no case should the white predominate. His horns should be long and of medium thickness, and go flat away from the crown, leaving a space of skin and hair between the roots. The sweep is slightly backwards and outwards, to leave space between the horns and the cheeks. His neck should be of medium length, carrying its thickness back, and attached firmly to strong, slightly laid back shoulders. The ribs behind the shoulder blades should be well arched and deep, the breast bone should come well through between the fore legs to give a large space for the vital organs. His back should be broad and flat, quarters long and level, with well-rounded fleshy gigots. His legs should be strong and sinewy, his bones flat, and he should stand well back on his pasterns on large wide feet; when he walks he should point his hocks slightly outward. His tail should be of fair length, thickly woolled, and should come down over his hocks. A good ewe has much the same points, but is of a refined and feminine character.

Successful management of Blackface sheep practically hinges on three points. light stocking, draining, and adequate burning of heather and rough grass. No breed of sheep can be expected to do well on ground that is overstocked: the change in appearance that takes place in the sheep on a farm from which even a few head have been removed, must be seen to be credited. Indeed it is no uncommon thing on an overstocked farm for the weaker members of the flock to die off, till the correct number is left on the ground. Draining improves not only the pasture but the climate, by taking away the chilly damp feeling from the atmosphere. It also removes the cause of several of the ills to which sheep flesh is heir. The old idea that burning of heather is injurious to game has happily been exploded, and it is now generally accepted that what is good for sheep is also good for grouse. All heather should be burned on a seven to ten years' rotation, which secures a plentiful crop of the young plant for both beast and bird. When burned as suggested, the new shoots come away soon and strong, while the direct opposite is the case where the old plants have been allowed to become trees. The rough grasses should be burned annually. This answers a double purpose by providing sweet young pasture, and by preventing the old grass from blowing into and choking up the drains. The provision of suitable shelters is also a matter deserving of great consideration. Youatt speaks of these in 1837 as having been first erected in Lanarkshire. Apparently, when he wrote, they were something quite novel, and he speaks of them as 'a commencement of improvement' in the matter of taking proper care of the flock. He describes the ones he saw as 'circular open stalls or pounds, the walls being 5 or 6 ft. high, and in a few cases surrounded by fir trees'. The want of these shelters was evidently badly felt in the days of Hogg, the Ettrick poet. He gives a lurid description of a storm which occurred about the middle of the 17th century:—" For thirteen days and nights the snow drift never once abated; the ground was covered with frozen snow when it commenced, and during all the time of its continuance the sheep never broke their fast. The cold was intense to a degree never before remembered, and about the fifth and sixth days of the storm the young sheep began to fall into a sleepy and torpid state, and all that were so affected in the evening died during the night. About the ninth and tenth days the shepherds began to build up huge semicircular walls of their dead, in order to afford some shelter to the remainder, but shelter availed little, for the want of food began to be felt so severely that they were frequently seen tearing one another's wool. When the storm abated on the fourteenth day, there was, on many a high-lying farm, not a living sheep to be seen, large misshapen walls of dead, surrounding a small prostrate flock, likewise all dead and frozen stiff in layers, were all that remained to the forlorn shepherd and his master In the extensive pastoral district of Eskdale Muir, which previously contained more than 20,000 sheep, only forty young wethers were left on one farm and five old ewes on another The farm of Phants remained without stock and without a tenant for forty years after the storm, and an extensive glen in Tweedsmuir became a common to which any man drove his flocks that pleased, and so it continued for nearly a century.'

The same writer tells of a storm in January, 1791. He says 'This storm fell with peculiar violence on that division of the South of Scotland that lies between Crawford Muir and the Border. In these bounds seventeen shepherds perished, and upwards of thirty were carried home insensible, who afterwards recovered The number of sheep that were lost outwent any possibility of calculation One farmer alone lost seventy-two scores, and many others in the same quarter from thirty to forty scores each'

Of course, it goes without saying that a good shepherd is absolutely essential to the well-being of the sheep Whether they are viewed on their native heath, or seen going through the sale ring, the evidences of good or indifferent herding are clearly marked. Fortunately for both the sheep and their owners, good careful men are much more common than careless or indifferent ones, and indeed it may be said, without fear of contradiction, that by no other class of workmen is more faithful service given.

Blackface sheep are unfortunately quite as subject to disease as those of other breeds. Owing, however, to the labours and experiments carried out by a Commission appointed by the Board of Agriculture in 1901, the two most fatal of these, viz. 'Braxy' and 'Louping Ill' or 'Trembling', have been proved preventable. About these ailments, however, it is unnecessary to say more, as they are treated of very fully under their proper headings.

Sheep scab has been brought into great prominence of late years. It is a most irritating and annoying skin disease, but is fortunately not only easily prevented but readily cured. Careful dipping is at once the cure and prevention, and sheep-farmers are under a deep obligation to the Board of Agriculture for the strong action taken in passing the Sheep Dipping Order of 1906, which has rendered the movement of sheep from one county or country into another a matter of comparatively little trouble. The regulations at present are that all sheep must be dipped twice in each year, once between 1st January and 31st August, and again between 1st September and 12th November It has been clearly proved that the best course to pursue is to have the two dippings within three weeks or a month of each other. At the first dipping all the living vermin are destroyed, but the eggs escape uninjured. By the time for second dipping all the eggs have hatched, and the young parasites are killed before they get time to deposit a fresh supply. Should the exigencies of the market make it necessary to have the first dipping done very early, say in July, it will be found a good plan to dip a third time within three weeks of the second.

The year on a Blackface sheep-farm may be said to commence when the 'crock' ewes are drawn off and sold, towards the end of September or beginning of October. Then comes the 'keiling' of the stock with the farm mark, usually done, to save a handling, when the hoggs are being sent away to wintering. About the 20th or 22nd of November the rams are put out to the ewes on the hill, where they remain till the first week of January. They are then brought into the parks and fed with oats, maize, and cakes till the beginning of April, when they are again turned out to the hill for summer. A liberal allowance of well-got meadow hay is also found to be most beneficial, and is much relished by the sheep In good weather, January, February, and March may be called the slack time, when the sheep require very little attention. Of course, in a stormy season the very reverse is the case, and the shepherds have to be on the constant lookout for squalls On 1st April the hoggs return from wintering, and are usually dipped before being turned out to the hill. Lambing commences on the 15th to 18th April, and for the ensuing three weeks the shepherds must be on the hill from morning to night. The lamb crop is determined chiefly by the character and elevation of the grazing, and may vary from 85 per cent on highlands to over 100 per cent in the more favoured low-lying districts. Not much goes on between the end of lambing and the middle or end of June, which allows time to the shepherds for the preparing of their stock of winter fuel. Then the lambs are marked, and usually the eild ewes and hoggs clipped. The clipping of the milk ewes follows in the second week of July, and after that the securing of the meadow hay receives the undivided attention of all hands. The first dipping is usually overtaken early in August, which ensures the showing of the sale lambs in fine bloom at the sales from the middle of August and onwards. In sorting the lambs, all the wethers are put away, unless the farm be one carrying a 'running' stock of mixed ewes and wethers, in which case the tops are retained. The top ewe lambs are always kept for stock, to the number of about one-fifth of the ewes; all the others are either marketed at once, or else wintered and sold in the early summer as hoggs As early as possible in September the entire stock is dipped for the second time, and, this job over, the season's work may be said to be completed.

The farmer, however, who goes in for rearing rams for show and sale purposes has practically no end to his work. The lambs selected for keeping are put on to good foggage at weaning time, and about the middle of October go into the house. The object being to have them ready to clip at New Year, care has to be taken that the thriving of the young animals goes on without the slightest check. To achieve this end, they are taught to eat artificial foods at a very early date, and indeed it is not an uncommon thing to feed both the lambs and their mothers through the summer. While in the house they get a liberal allowance of mixed grains and cake, with as much good hay and fresh water as they will consume, and a hot supper of boiled barley and bran usually forms an item on the menu. After clipping, an increased diet is given, as naturally the sheep misses his wool and requires extra food to keep up the heat About the beginning of May the doors are opened, the sheep allowed to run out and in, and from then on to sale time the feeding is gradually increased Throughout the summer, cabbages form a very important item in the bill of fare, and every successful exhibitor sees to it that he has an ample supply of both the early and late varieties.

While there is no general Flock Book for Blackface sheep, every breeder of note keeps a most particular record of the pedigree of both his rams and his ewes. The Breed Society is called 'The Blackface Sheep Breeders' Association' The annual meetings are held at Lanark and Perth in alternate years, on the evening preceding the September ram sales. The association was formed in 1901, and has for its object the furtherance of the interests of the breed in every way possible. Its system of giving prizes for wether lambs at the great Christmas and Spring sales of fat stock has proved most successful, and has done not a little good in bringing prominently to the notice of feeders the good qualities of the lambs.

In writing of the more successful breeders of to-day it would ill become anyone to forget the pioneers who planted and watered the good seed more than a hundred years ago. In the statistical account of Scotland of 1795, David Dun of Kirkton is described as having 'the best stock of Blackface ewes that are to be met with in Scotland'. About this Mr. Dun we know little, but the lands of Kirkton, near Campsie, in Stirlingshire, were afterwards merged into the farm of Knowehead, which became so famous in the occupancy of the Messrs. Foyer. All through the first half of last century we find prominent mention of Foyer of Knowehead and M'Kersie of Glenbuck, in Ayrshire, and undoubtedly every well-known stock of the present day can trace back to the original sheep in the possession of these two breeders. There was a celebrated ewe stock on Glenbuck in the 18th century, when the property came into the possession of the Cumberland Mining Company This concern, however, shortly afterwards failed, the stock was dispersed, and the new tenant substituted wethers. In 1811 Mr. M'Kersie became tenant, and at once put away the wethers, and succeeded in buying back a few ewe lambs whose descent could be traced back to the original stock. In 1872 Mr. Howatson, who had for ten years been first tenant and then proprietor of Crossflatt, bought the property, and everyone knows how world-wide the fame of the stock has since become. On Crossflatt, Mr Howatson had, with infinite trouble and painstaking, succeeded in developing a stock second to none, and the two properties being within view of each other, and both being in Mr. Howatson's own occupation, the stocks became pretty nearly identical. In 1903 Mr. James Clark entered upon a lease of Crossflatt, and the figures of the two valuations, when Mr. Howatson took over the stock in 1863 and when he parted with it forty years later, are very interesting and instructive.

The figures are —

	1863
Ewe and lamb	28s. 7*d* each ewe.
Ewe hoggs	23s. 4*d* each.
	1903
Stud ewes and lambs	£6, 10*s*. each ewe
Hill ewes and lambs	£4, 14s. ,,
Ewe hoggs	£2, 18s. each.

Mr. Howatson's highest price for a ram was made in 1898, when he sold 'Scotland Yet' to Mr. Dunlop, Dunure Mains, for £200. This constitutes the record price for the breed His highest average was made in the same year, when he received £81, 16*s* each for a group of five shearlings. Mr. Howatson has set up another record in having gained first prize for shearlings at twelve consecutive Highland shows.

In the hands of their new owner, Crossflatt sheep continue to command high prices, and at the Highland Show held at Glasgow in 1905, Mr. Clark carried off the championship with his winning shearling 'Heather Bell', and also the Sinclair Scott trophy for the best group of two males, two females, and one lamb of either sex, the produce of the ewe exhibited in the group.

The name Cadzow of Borland has for many years been familiar to all lovers of sheep. Since 1880, when they entered upon the tenancy of Borland, their sheep have won numerous distinctions, including the Breed championship at the Highland Show in 1906, and at Lanark ram sale of 1907 they sold four sheep at £100 each and over, and set up the astonishing record of £98 for the first prize group of five shearlings and the Sinclair Scott trophy in 1906 and 1907.

Other names which stand out prominently as successful breeders of Blackface sheep are Hamilton of Woolfords, the Archibalds of Overshiels, M'Dougall of Claggan, and Buchanan of Lettre, all of whom are regular exhibitors at the leading shows. It must not, however, be supposed that these stand alone in regard to the excellency of the sheep bred by them. This will readily be seen from a glance at the following table, which shows the best averages obtained for rams at the Lanark and Perth sales in 1907.—

LANARK.

Breeder	Number	Highest			Average		
		£	s	d	£	s	d
Messrs Cadzow, Borland, Lanarkshire	20	140	0	0	41	14	6
Mr Howatson, Glenbuck, Ayrshire	10	115	0	0	33	11	0
Mr Hamilton, Woolfords, Midlothian	13	80	0	0	22	18	5
Mr. Lees, Lagg, Ayrshire	9	103	0	0	20	4	5
Mr Clark, Crossflatt, Ayrshire	11	57	0	0	19	14	6
Mr Fraser, Rankinston, Ayrshire	17	38	0	0	19	8	2
Mr. Lumsden, Arden, Dumbarton	6	30	0	0	19	3	4
Col M'Kenzie, Muirhouses, Dumbarton	13	35	0	0	16	17	7
Mr Calder, Ledlanet, Perthshire	10	40	0	0	15	8	0
Mr. Howatson, Carskeoch, Ayrshire	7	38	0	0	15	7	1
Mr Scott, Bogside, Lanark	15	36	0	0	12	8	8
Mr Mitchell, Hazleside, Lanark	30	35	0	0	11	6	0
Mr. Hamilton, Nether Wellwood, Ayrshire	10	43	0	0	10	18	6
Mr. Hope, South Brownhill, Lanark	9	14	0	0	10	6	8
Mr. Archibald, Overshiels, Midlothian	28	28	0	0	10	3	2
Mr Hamilton, South Cumberhead, Lanark	12	30	0	0	8	15	5
Messrs. Macmillan, Glencrosh, Dumfries	7	26	0	0	8	10	0

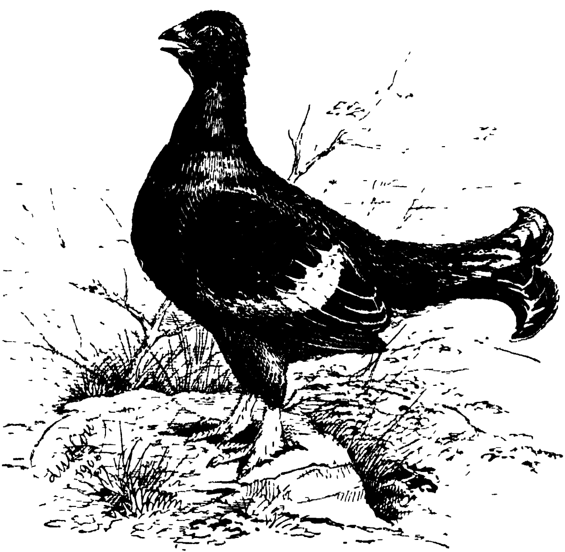
PERTH

Breeder	Number	Highest			Average		
		£	s	d	£	s	d
Mr Campbell, Kerromore, Perth	5	31	0	0	15	3	0
Mr M'Dougall, Claggan, Perth	16	36	0	0	14	18	9
Mr Clark, Crossflatt, Ayr	13	20	0	0	13	9	3
Mr. Hamilton, Woolfords, Midlothian	13	50	0	0	13	3	1
Mr. Howatson, Glenbuck, Ayr	16	30	0	0	13	1	4
Mr. Buchanan, Lettre, Stirling	40	90	0	0	12	15	6
Mr. Sandilands, Corsebank, Dumfries	16	52	0	0	12	8	2
Mr. Archibald, Overshiels, Midlothian	30	65	0	0	11	19	0
Mr Scott, Bogside, Lanark	20	36	0	0	10	19	5
Messrs. Cadzow, Borland, Lanark	60	85	0	0	10	14	2
Mr. Calder, Ledlanet, Perth	10	16	0	0	10	13	0
Mr M'Intyre, Tighnablair, Perth	14	26	0	0	10	8	11
Col M'Kenzie, Muirhouses, Dumbarton	15	40	0	0	10	5	0
Mr. Macdonald, Urlar, Perth	8	16	0	0	9	18	2
Mr. Hope, South Brownhill, Lanark	14	20	0	0	9	11	0
Mr. Fraser, Rankinston, Ayr	16	48	0	0	9	10	7
Mr. Brydon, Burncastle, Berwick	18	26	0	0	9	9	6
Mr Pate, West Browncastle, Lanark	9	18	0	0	9	7	9
Dr. Watson, East Browncastle, Lanark	9	13	0	0	9	3	4
Mr. Craig, Kinnox, Lanark	9	16	0	0	9	2	9
Mr. Lees, Lagg, Ayr	12	30	0	0	9	2	1
Mr. Buchanan, Blairquosh, Stirling	9	15	0	0	9	1	8
Mr. Whyte, Spott, Forfar	32	16	0	0	8	16	3
Mr. Macrae, Stenhouse, Dumfries	17	19	0	0	8	1	9

A good many breeders prefer to sell their rams as lambs, and thus save the trouble and risk of feeding them. Not a few buyers also prefer to buy lambs, in order that they may winter them to please themselves, with the result that for good lambs there is usually a first-rate demand.

Until about the year 1857 the market held at West Linton in the end of June was the most important for Blackfaces in Scotland, and hence the origin of the name 'Linton', which seems to have been commonly applied to the whole breed. After that date Lanark became the chief market, and probably continues so at the present time. Very large sales are also held at Ayr, Peebles, Castle Douglas, Thornhill, and Biggar in the south of Scotland, and in the north at Perth, Stirling, Oban, and Inverness. Sales by private bargain seem to become fewer every year, and practically every town of any importance is now supplied with an auction mart.

It has been stated already that Blackface sheep, grown under favourable circumstances, mature early, but the fact must never be lost sight of that this is by no means the principal characteristic of the breed. The points breeders must aim at acquiring and retaining in their flocks are: hardiness of constitution, the ability to endure any amount of winter storms and spring barrenness on land at any altitude, and the power to come up fresh and smiling at five and six years of age. If a farmer attempts to breed big soft wether lambs for early maturity under any but the most favourable conditions he can only expect to spoil his ewe stock Let him use none but well-bred rams possessing good bones, heads, and frames, and of a size suitable to his ground, and his wether lambs will have all the early maturity points it is safe to try for. It is very easy to lose the substance by grasping at the shadow, and once gone it is apt to be gone for ever. [R. M]



Black Grouse

Black Game (order, Gallinæ; family, Tetraonidæ) —The male of the black grouse (*Tetrao* *ix*, Linn.) is known as the blackcock, the ale is called the greyhen.

The plumage of the adult blackcock is mostly ck, the feathers of the neck and back reflect- metallic blue lights. The primary feathers the wing are black with white shafts; secon- ies and tertiaries black with white bases, ich show as a white bar on the wing, the ler wing-coverts being pure-white, as are the under tail-coverts. The thigh and vent thers are very dark grey marked with white, legs being feathered to the end of the tarso- tatarsus, but the metatarsals (toes) are bare, of a blackish colour. The beak is black; the irides dark-brown; above the eye is a patch of bare skin of a brilliant scarlet. But the glory of the blackcock consists in his upper tail-coverts, eighteen in number, of which the outer three to five on each side are elongated and curl outwards, the others being square at the ends. This conspicuous ornament is made to play a great part in the display customary in courtship. The total length of the blackcock is 22 in.

The greyhen forms a striking contrast to her mate, her general colour being ashen-brown, barred and spotted with black. The breast feathers, especially on old birds, are edged with pale-grey or white; the under tail-coverts are greyish-white, feathers on the legs pale-brown, beak and irides hazel brown. Like the cock, she has a patch of bare skin over the eye, bright-scarlet.

This handsome bird has a very wide range in Europe, extending from 69° N. lat to the Apennines and the Catalonian Pyrenees, and from Holland and France to the Volga. Probably it was plentiful originally on all the heathlands of Great Britain, but it is not known ever to have existed in Ireland, where all attempts to introduce it have failed, nor is it found in the Orkney and Shetland Islands nor in the Outer Hebrides Yarrell states that black game having become extinct in Surrey, Mr H. M Thornton of Chobham brought two blackcocks and three greyhens from Holland in 1815, and turned them out in the Hurt Wood, between Leith Hill and Hindhead. They bred well, and their progeny spread all over the heathlands between Farnham and Bagshot, where the present writer remembers them fairly plentiful forty years ago; but the great multiplication of villas and other residences over most of that district, combined with the camps of Aldershot and Pirbright, have been fatal to these birds, and they are now probably quite extinct once more. Black game, however, still exist in the New Forest, on Dartmoor, Exmoor, and in the counties of Somerset, Worcester, and Stafford. They have also been re-introduced with success on the Duke of Bedford's estate of Woburn Abbey in Bedfordshire.

Farther north, black game are more abundant, being found in varying numbers in the wild and semi-cultivated parts of northern England and Scotland; but in most districts they are far less numerous than was formerly the case. This is owing to a variety of causes, such as the practice of letting shootings to different tenants in successive seasons, to the improvement in sporting guns, and to the abandonment of tillage in hill and moorland districts. The close time provided by the game laws extends from 11th December till 19th August, both days inclusive. It would be far better to make it coincide with that for pheasants, namely, from 2nd February till 30th September, for black game resemble pheasants in many respects, and much injury is done to the race through the slaughter of immature poults in August and September by inconsiderate or inexperienced sportsmen.

Black game are polygamous. The cock birds assemble in spring upon some appointed knoll and go through a variety of antics, strutting like turkey cocks with trailing wings and expanded tail feathers, dancing, making sham fight, and uttering a soft, gurgling sound, not unlike the call of the turtle-dove. It is a beautiful and interesting sight to watch these glossy birds on an April morning, as many as twenty or thirty frequenting the same meeting-place. The greyhens gather to the assembly, which takes place both morning and evening, and often fly thither a distance of several miles. They take a very unobtrusive part in the proceedings, waiting about until their lords have finished dancing and striking attitudes, and can spare a few moments to pay those attentions to which their humble spouses are entitled as the prospective mothers of a new generation.

This brief intercourse is the only one that takes place between the sexes. At all other seasons blackcocks keep apart from the hens, taking no share in rearing the poults, and gathering into large flocks in winter to the number sometimes of eighty to a hundred, when they present in flight one of the most striking displays that can be witnessed among the birds of these islands.

If the blackcock makes a careless husband, the greyhen cannot be called an exemplary mother, showing, as a rule, when flushed greater solicitude for her own safety than for that of her offspring. The greyhen's nest is a very slight affair on the ground, sheltered by heather or rushes, wherein she lays in May six to ten eggs, pale-buff speckled with rich-brown.

Black game are as much at home in woods as on the moors. Their food consists of berries, especially the blaeberry, seeds of various herbs, birch buds, young shoots of pine, caterpillars, flies and other insects, and grain of all kinds. They are very destructive to corn crops, trampling it down when growing, and devouring large quantities of grain in the stook. Ample consideration is due on this account to farmers whose land, bordering on the moors, is liable to inroads by these large fowls. The extent to which black game depend upon grain for subsistence has been proved in Nithsdale, which was thirty years ago, and still remains, the best black-game district in Britain. The five best seasons on the Duke of Buccleuch's Drumlanrig estate were as follows —

1861	1586	Black game
1865	1530	
1869	1508	
1870	1486	
1871	1429	

The largest bag ever obtained in a single day's driving on the duke's moors at Sanquhar included 247 black game killed by ten guns; but on October 9th, 1874, on the duke's Langholm estate, two gentlemen killed 98 black cocks in a single day. Arable farming having been largely discontinued in these valleys, and the land laid down to pasture, black game have so much diminished in numbers that 20 or 30 brace is now considered a fair bag.

In Galloway black game are still numerous in the valley of the Cree and on the moors about New Luce. On Lord Stair's property in Wigtownshire a party of guns killed 100 brace of grouse and 104 black game in a single day in 1906.

The flesh of black game is excellent, not so highly flavoured as that of grouse, and, when cooked, curiously streaked with layers of brown and white. Old birds require to be hung some time to give them tenderness, but the meat of birds of the first year is delicious.

Hybrids between the black grouse and the pheasant have frequently occurred; those between the black and red grouse have been recorded, but are very rare, as might be expected, seeing that the black grouse is polygamous and the red grouse pairs. Hybrids of capercailzie and black grouse (both polygamous birds) are not uncommon in Scandinavia, and Yarrell reports an instance of a cross between a blackcock and a willow grouse (*Lagopus albus*).
[H. M.]

Black Horse, Old English. See SHIRE HORSE.

Black Leg. See BLACK QUARTER.

Black Medick. This name, which is sometimes given to Trefoil or Yellow Clover, refers to its head of black spiral seedpods. See MEDICAGO.

Black Pigs.—During the seventies and eighties several of the southernmost counties of England claimed to have the best local breed of black pigs. These varied in type and size very considerably, from the pretty and compact Small Black bred in Suffolk and a portion of the county of Essex adjoining, to the more useful but somewhat flat-sided, long-bodied Black found in the western portion of Essex, and the equally massive but not more handsome Large Black kept on a considerable scale in the extreme south-west of England. As this last kind has now a herd-book society to look after its interests, the membership of it numbering some hundreds, this breed must be considered to be of sufficient importance to warrant a separate notice. The handsome but not excessively useful Small Black, which was said to have owed much of its wonderful aptitude to lay on flesh to the imported Neapolitan pig, was quite fashionable in the years following 1870, when the fashion for neat, compact, and early maturing animals first became general. When nicely trained, and its profuse coat of fine hair lightly oiled, it certainly presented a pretty picture; but, like the Small White, it suffered so much from the well-meant attempts of its admirers to cultivate its appearance from the exhibitor's point of view, and its commercial value suffered to so great an extent, that when the demand for lean pork set in strongly, the Small Black quickly lost caste. About a quarter of a century or more since, a pig of a similar character, but with less hair and the skin of a colour tending to blue slate, was bred in the county of Dorset, and was very successful in the classes for pigs of a black breed at the Smithfield Club's shows in London. These pigs were on a somewhat larger scale, with longer snouts, and not so compact or nice-looking, whilst the proportion of fat to lean in their flesh was if anything greater than that possessed by pigs of the Small Black breed. The change in taste has had the same disastrous effects on the Dorset as on the other small and fat-producing breeds of pigs.

Another breed of black pigs very similar in colour and sparseness of hair was bred very generally in the county of Sussex; but here the similarity ended, as the breeders appear to have studied the commercial and practical rather than the exhibition points of their pigs, which were on a much larger scale, stronger in the bone, longer and deeper in the body, more prolific, and far better mothers. As might be expected, the little pigs grew more quickly, were hardier, and required less care and attention. The real old-fashioned Sussex pig, when fully matured and fattened, was, however, somewhat coarse in bone and flesh; this drawback has been minimized very considerably by the infusion of Berkshire blood, and the selection for breeding purposes of the better-quality youngsters. This improvement has enabled the Sussex pig to retain its place, and even to extend its borders farther west, since it is hardy, a good forager, the sows are prolific and good milkers, whilst its feeding qualities are fairly good. For a considerable number of years large numbers of black pigs, or pigs chiefly black with white or sandy spots, have been bred in the counties of Leicester and Northampton. It has been claimed that this type of pig furnished the chief portion of the blood on which the old-time Berkshire was founded. The fact is that even now we occasionally find some of the young Berkshire pigs show symptoms of these sandy and white spots.

Still another county claims to have a special breed of black pigs, namely Hampshire. There are many black pigs bred in this county not unlike the Sussex type, save that these pigs are somewhat higher on the leg, of a rather larger size, and darker in colour. Some of these pigs, again, appear to have been crossed with a Small Black or a Berkshire boar; this has reduced the size and length of leg, and has increased the aptitude to fatten of the produce. [s. s.]

Black Pine, also called the Austrian Pine. See PINE.

Black Poplar, a rapidly growing tree of the genus Populus. See POPLAR.

Black Quarter, Black Leg, Quarter Ill, Struck, Pook, &c. — Under the above, and some other names peculiar to certain localities, a fatal disease is known among farm stock, and is due to the entrance into the tissues of the body of a germ similar to but not identical with that of anthrax. Cattle, sheep, goats, and rabbits are readily inoculated, with fatal results. Local swellings only are produced by similar treatment of horses, asses, and white rats. Black rats, pigs, dogs, and man are immune. The bacterium or bacillus of black quarter probably enters the body by wounds or minute abrasions in the legs and feet, and through similar openings in the mucous lining membrane of the mouth or other portions of the alimentary canal. Calves between the ages of seven and seventeen months are the most susceptible subjects, but it may occur in animals of any age. Thriving yearlings are perhaps oftener struck than those in less robust health, and lambs making flesh rapidly would also appear to be more susceptible than the unthrifty. This generally accepted belief has been questioned by investigators, but would seem to have some substantial foundation, or it would probably not be so universally held. Certainly it has been the experience of the writer, who has lived in districts where it was sadly rife.

While chiefly striking young creatures at pasture, it is by no means rare in the straw yard, when animals are fed upon hay or other dry provender grown upon infected soil. There are special seasons of danger, as when a lush crop of grass follows on a dry summer and autumn rains, or in the rapid growth of pasture plants in an early and warm spring. In the latter conditions, it occurs almost as soon as the young stock begin to respond to the more generous keep, but not during the first two or three days. Black quarter is of less frequency in the better-cultivated districts of the north of England than formerly, owing to the practice of keeping calves better during the first few months, the loss of calf-flesh predisposing them apparently to disease. No evil consequences can be traced to the consumption of the unaffected portions of an animal that has been slaughtered while a limb or part has been the subject of this malady, but its devotion to human food is inconsistent with modern views of hygiene, and the practice should be discountenanced.

Symptoms. — The stricken animal leaves the herd, and appears more or less rooted to the ground. When compelled to move, he does so with difficulty, wherever he may be struck. A hind or fore limb being most often affected accounts for the popular name of quarter ill, but the internal organs may be the seat of the trouble, and then the name of pook or puck lends colour to the superstition that the little god of mischief has struck the fatal blow. These cases, too, are sometimes confused with lightning stroke. See LIGHTNING.

The helplessness of the animal, when a limb is affected, is even suggestive of fracture of a bone, but manipulation soon discovers a characteristic diffused swelling, which emits a crackling sound when stroked by the hand, and a feeling of crepitus, proving the presence of gases under the skin. The dejection of the animal is marked. The ears droop, the head hangs low, and the expression is that of one 'marked for death', as men say in such districts. The temperature rises to 104° or 105° F., sometimes higher if the case is advanced, but always falling before dissolution takes place.

Treatment is so unsatisfactory that no young animal should be kept alive after a satisfactory diagnosis has been made. It should be killed by a heavy blow upon the skull, and without spilling of blood, or else carted away to a more convenient place, for slaughter by the ordinary means. The ground upon which it stood should be thickly covered with quicklime, and the spot fenced off to prevent the curiosity of the herd 'nosing' over the infected spot A few brambles and brushwood burned over it makes a satisfactory disinfection Cremation of the carcass is the most desirable means of disposing of all animals that have died of infectious diseases (see Carcasses, Destruction of) Failing this method, deep burial in quicklime is recommended, a grave 6 ft deep being advised Adult animals have recovered under treatment, and Mr Thompson, veterinary lecturer to the Aspatria Agricultural College, says 'In adult cases I have had most success with the following prescription, namely, 1 oz of hyposulphite of soda and 1 oz. charcoal given every six or eight hours in water, and 10 to 15 oz of linseed oil given every other day'

Prevention Many means have been adopted, some having their origin in forgotten superstitions Many persons still believe that the presence of a goat is a safeguard, his mischievous propensities perhaps being pitted against those of Puck; others attach importance to turning out on particular days, or in certain phases of the moon For centuries, much faith has been placed in setoning the dewlap, the tape being smeared with a blistering substance before insertion in the skin. This gives rise to much swelling and the formation of matter, which is regarded as desirable, to carry off the humours The authority previously quoted (Mr Thompson, M R C V S) says of the seton when inserted in September or October 'I have treated some hundreds in this manner, and yet have never seen one animal which had been setoned become affected with black quarter' The writer has done some thousands, but cannot give the same testimony, nor is the value of this remedy any longer esteemed by recognized leaders of the veterinary world, on the contrary, they place confidence in the system of immunization by a serum or culture, popularly known as a vaccine. Many fatal accidents attended inoculation with the earlier preparations, as it was found that their escape into the connective tissue (when intended to be injected direct into muscular substance) produced the malady from which it was meant to give protection. Cords impregnated with the protective virus are now prepared, and largely employed, with a degree of success unknown to any practitioners of the older methods. In some parts of Europe protective inoculation has alone enabled cattle-rearing to be conducted profitably It should have been said that to the famous French chemist Pasteur the credit of the original discovery belonged. As with some other diseases due to specific organisms dwelling in the soil, the plough is a powerful deterrent Some 'pooky' lands, abandoned by men with knowledge of their unfortunate character, have been since occupied by tenants, with an arrangement between themselves and the landlord by which it is agreed that all young stock shall be immunized by a properly qualified veterinary surgeon; and that in the case of any deaths occurring, the veterinary surgeon shall be called in to make a post-mortem examination, the other party to the contract being notified in time to be present or represented at the autopsy; and if the cause is certified to be black leg, then the landlord bears the loss, or such portion of it as may have been previously agreed upon Held upon these terms, there is inducement to owners and occupiers to drain and clean the land, and reduce the risk, while neither party can be ruined by losses sustained. Such contracts need to be very clearly defined, and all animals dying should be examined by an expert. There are cases of struck animals where the first and only symptom to the looker-on is that of sudden mania, the animal throwing up its head like an angry bull, and dashing at full gallop, heedless of solid obstacles, falling only to die, if not dashing itself against a tree or fence Either anthrax or the disease we have been considering is the cause of these maniacal attacks, and ignorance of their origin has allowed the loss to fall upon the shoulders of the wrong individual.

[H L]

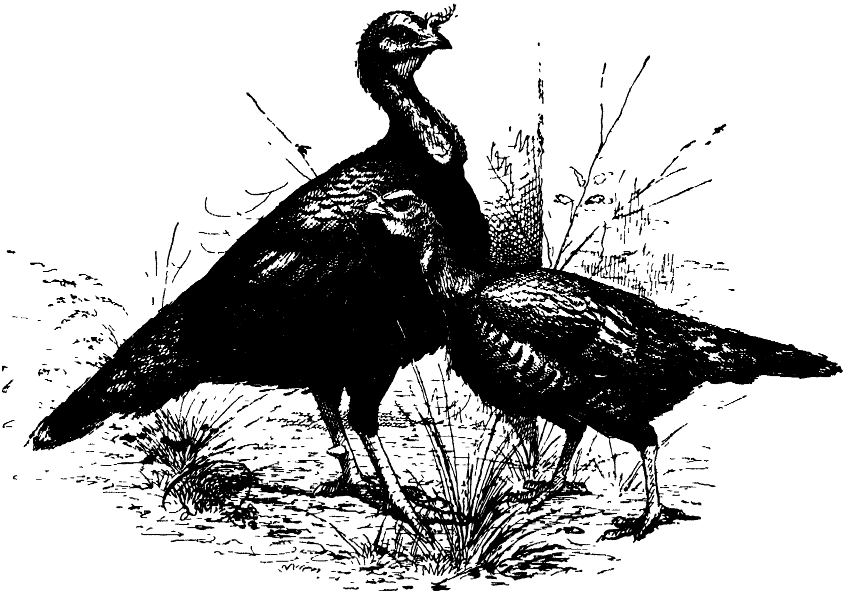
Black Spruce, a species of Spruce frequently seen in parks and arboreta in Britain. See Spruce

Blackthorn or **Sloe** (*Prunus spinosa*), a shrub of the same genus as the Plum. It flowers freely in hedges and along country lanes in early spring, before the woodland trees have begun to flush their foliage Its snow-white flowers generally come in profusion from the spiny shoots before the leaf-buds open, and make its appearance a charming harbinger of Spring's advent Its almost globular fruit is small and pale-blue with blackish bloom, and is still used for making the deep violet-coloured sloe-gin. The Blackthorn is frequently found among the underwood in copses, where it is usually an unwelcome and rather useless intruder, although its shoots make good walking sticks It is, however, most abundant in thickets and along the borders of woods and in hedgerows But it is not a good hedge plant, and in the very oldest book on English rural economy, The Book of Husbandry, by Master Fitzherbert (1531), its use in hedge-making was deprecated in words that apply equally well to-day. 'But get no blackthorn for nothing, for that will grow outward into the pasture, and doth much hurt in the grass, and tearing the wool of the sheep'

[J. N.]

Black Turkey.— At one time the turkeys found throughout western, southern, and mid-Europe were either black or sports therefrom, the former predominating, as is still the case upon the Continent This appears to be explainable by the fact that the Mexican Turkey, which was the progenitor of nearly all the older European varieties, is largely black in plumage, or, at any rate, very dark, and as the Spaniards appear to have a strong predilection for black feathered poultry, their influence has been very great indeed. We have no actual information as to the colour of the Turkey when first imported into Spain from the Western Hemisphere, but as they came from Mexico it may safely be assumed that they were similar to those still found in that country. Whilst it is correct to state that Black Turkeys are widely distributed—for the writer has met with them all over Europe from Russia to the Atlantic—the best representatives are the Norfolk and the French, as they have been most carefully bred, and are the finest in size and flesh qualities Generally speaking, these conform to the shape and carriage of the turkey (see TURKEY, BREEDS OF), except that they are dark in colour of leg, are light in bone, and do not attain the weight reached by the American Bronze (see AMERICAN BRONZE TURKEY), the males being, when fully grown, 20 to 22 lb., and the females 12 to 14 lb. These are heavier than some of the other races, and the Blacks appear to stand midway between the extremes of size in both directions. They are long in body, and the breast is carried well forward, whilst the frame is deep, and the wings are very large indeed.

As already mentioned, there are two leading varieties, namely the Norfolk and the French, and although these are generally described separately, for our present purpose they may be regarded as the same, such minor differences as may appear being due to selection The main difference is in coloration of plumage. The French is glossy black, without any white or coloured feathers, whilst the Norfolk is duller in hue, and some of the feathers in the tail and on the back have white or brownish tips, giving the appearance of a little mottling or spangling. In some cases these markings are seen on other parts of the body, but black in every way predominates Unfortunately there are very few of the Norfolk Turkeys now to be met with, as their place has been largely taken by the American Bronze, consequent upon the larger size of that variety, though in other respects the change is not altogether advantageous. A contributory cause appears to have been the gradual weakening of the race through long-continued breeding in the same district, and, probably, want of care in the avoidance of inbreeding, both of which are bound to demand a penalty and to bring about degeneracy of constitution. At the time when American Bronze Turkeys were introduced, the need for fresh stock was increasingly manifest, and thus there was good reason for its adoption, but it is to be regretted that steps were not taken to retain the old breed by giving to it that vigour it lacked. It may, therefore, be admitted that the French Turkey has maintained its position, whilst that of the Norfolk has been lost In respect to quality these two forms are very nearly allied, as the flesh is abundant, beautifully white and soft, and fine in texture and flavour, doubtless due to these birds having been reared for generations upon some of the finest land in eastern England and in Normandy. Like all members of the Turkey family they require very great care during the earlier stages of growth, but the general experience is that where the soil is suitable, and they are raised in a natural manner, they are rapid in growth. As already referred to, they are light in bone as compared to the total weight of body—in itself a sign of good meat properties. [E. B.]



Black Turkeys

Black Water.—A disease of cattle, so called from the reddish-black appearance of the urine. It is more commonly known as Red Water. See RED WATER.

Bladder, Diseases of.—Diseases of the bladder are not nearly so common as is generally supposed, but when present there is usually some disturbance of the passage of the urine, such as retention, when no urine is passed for a considerable period; incontinence, when there is a difficulty in retaining it, the urine dribbling away constantly; strangury, when the passage is accompanied with much pain, and is performed drop by drop, dysury, when pain accompanies every expulsion.

In most cases of disease of the bladder there is also a change in the composition of the urine, the chemical properties are altered, and it occasionally contains substances foreign to it, such as broken-down cells, blood, and pus. In all cases of suspected bladder trouble it is well, therefore, to make an early examination of the urine with regard to its colour, consistency, and smell.

Occasionally diseases of the bladder are due to and dependent on other concurrent diseases, such as inflammation of the kidneys (nephritis), inflammation of the bowels (peritonitis), and the presence of pus in the kidneys (pyelo-nephritis).

The use of a surgically dirty catheter, in drawing off the urine, may quite easily cause infection with bacteria. Certain drugs also, that act as diuretics, such as turpentine and cantharides, may set up great irritation in the mucous or lining membrane if used in excess or improperly by those unacquainted with their medicinal actions. Cases are on record where excessive blistering with cantharides ointment has set up bladder trouble from absorption through the skin.

Retention of urine occurs mostly in the castrated male, and may be due to a variety of causes, the danger being in the continued secretion of urine, without proper periodical outlet, causing rupture and subsequent inflammation of the bowels (peritonitis).

The cause is some obstruction to the outlet, such as might arise from the presence of stones (calculi) or other foreign substances in the bladder or urethra (the tube through which the urine passes from the bladder). Spasm of the sphincter muscle around the neck, disease of the adjacent prostate gland, and paralysis of the bladder itself are also possible causes.

The symptoms, in addition to the difficulties of passage, are the presence of pain, and restlessness, especially in horses and dogs. In the smaller animals we may feel the distended bladder from the outside, but this must be gently done, to avoid any possible chance of rupturing.

The treatment consists of passing a clean catheter and drawing off the urine. This is an easy operation in females, but more difficult in males. In the ox and ram it is impossible to pass the catheter unless an artificial opening is made above the S-shaped bend that is present in the urethra of these animals. Should calculi be present, they must be removed by surgical means. Rubbing the abdomen, in the region of the bladder, with a turpentine liniment is helpful in cases of paralysis and spasm of the sphincter, together with internal administration of some sedative, such as chloral hydrate, in appropriate doses.

Rupture of the bladder may also occur when fully distended from any violent strain, such as, in the case of dogs, that due to being run over. The symptoms are sudden cessation of pain, and the inability to feel the distension from the outside. Successful treatment depends mainly on early diagnosis, and prompt suturing of the ruptured walls under an anæsthetic and strict antiseptic precautions.

Incontinence of urine may be due to a relaxation of the sphincter muscle, or to some irritability of the bladder, such as might arise from the presence of a calculus, or from some alteration in the normal constituents of the urine, rendering it too acid. Prolonged retention may lead to it, by causing a weakness of the sphincter and affections of the spinal cord.

The treatment consists of the administration of strychnine, either in the form of the liquor strychninæ or the tincture of nux vomica. Douching the bladder with cold water, by means of a catheter and funnel, should act beneficially in restoring 'tone'.

Strangury may arise from some inflammatory conditions of the neck of the bladder, or from spasm of the sphincter.

Dysury is seen in most cases of calculus, and in inflammation of the urethra.

Inflammation of the bladder (cystitis) may be caused by the action of bacteria, their mode of access being by way of the blood stream, by introduction with a dirty catheter, by a backward infection through the urethra, or by the lymphatics. It may arise from other inflammatory diseases of the peritoneal cavity, the presence of calculi, and possibly also from the blocking of the urethra by small calculi, causing retention of urine and subsequent partial decomposition.

The symptoms of acute cystitis are interference with the process of micturition, and, in horses, attacks resembling those of colic. There is constant straining and efforts to pass urine, resulting in the passage of a few drops only. The gait is wide and straggling, pulse frequent, temperature high, and in the later stages great depression, the result of uræmic poisoning. Constipation is generally present, respiration quickened, and the appetite almost gone, blood and pus may be found in the urine, and there is considerable thirst.

The presence or otherwise of calculi is ascertained by external manipulation, in those animals small enough to permit of it; in others, such as the horse and ox, an examination is made per rectum. In all, a flexible sound may be passed through the urethra into the bladder, in a similar manner to the passing of a catheter; should it come in contact with a calculus, the jar can be distinctly felt.

The treatment of cystitis should aim at reducing the inflammation; to this end hot stupes should be frequently and carefully applied. An old rug may be folded in three and wrung out of boiling water, applied to the loins, and covered with a waterproof cloth. This should be repeated at twenty minutes intervals until relief is obtained. Boric acid and hyoscyamus may be given internally, and in the case of horses and cattle, bicarbonate of soda in the drinking water, or mixed with demulcents, such as linseed tea or barley water. The bowels should be kept in a relaxed condition by the administration of small doses of sulphate of magnesia.

A rational method of treatment is the irrigation of the bladder, by means of a double catheter, with a saturated solution of boracic acid and warm (not hot) water

When calculi are present they may consist of a single stone or of a varying number of small ones, or they may take the shape of gravel In any of these forms they may nearly fill the bladder. Accompanying these cases there is generally some catarrh of the mucous membrane, and pus present in the urine.

The formation of the bladder stones or vesical calculi varies In herbivora they are composed of triple phosphates and carbonate of calcium, and are greyish in colour, when a reddish tinge is present, it is due to salts of iron.

Most of them present a smooth surface, but occasionally they are roughened, which is due to a covering of oxalate of calcium In dogs and the carnivora generally, the composition is altered by the addition of ammonium; they are white in colour, and of smooth surface. Those having a yellowish tinge and possessing a rough surface contain oxalate of ammonium. Another kind is known as cystic calculi; they are greasy to the touch, yellowish in colour, and easily broken when dried.

In geldings, calculi in the bladder (vesical) or urethra (urethral) are distinctly rare; in mares, owing to a comparatively wide urethra, they are usually dislodged and pass away with the urine, so that vesical calculi are generally the only ones found in them.

In either case the symptoms are much the same, save that in the case of vesical calculi the urine is more often tinged with blood, owing to injury of the bladder wall by the stone itself. Differentiation can be made, by an examination per rectum, or in mares by a digital exploration through the urethra. The only treatment likely to be of any permanent success is surgical removal. When situated near the end of the urethra this may be comparatively easy: the stone, after being located, is seized by a pair of forceps and drawn out. Should it be too far up for this method, it is necessary to make an artificial opening under antiseptic precautions for its removal. In the case of vesical calculus in the mare it is possible, if the stone is of small size, to remove it by forceps after dilating the mouth of the urethra; otherwise the opening must be enlarged by cutting, and the calculus removed with forceps. Another method is to crush the stone with an instrument called a lithotrite, after which it is removed in pieces.

In geldings it is necessary to make an artificial opening through the perinæum (region lying between rectum and scrotum) into the urethra in order to get into the bladder.

Immediately the stone is removed the urine flows away, and after making sure that nothing is left behind, the wound is cleansed and stitched up. Subsequently the bladder should be washed out once daily with a two-per-cent solution of acetate of alumina.

Of all domesticated animals, the ox is probably most inclined to formation of calculi; they are usually small and formed in the bladder, from which they pass into the urethra, and are generally arrested in the first part of the S-shaped bend.

The symptoms are similar to those of other animals, but there is more fretfulness, whisking of the tail, and a tendency to strike the body with the hind feet If the pain suddenly ceases, and no distension of the bladder can be felt per rectum, probably it has ruptured, in which case the animal should be promptly slaughtered, before the flesh has time to get tainted from the absorption of the urine.

In sheep, calculi are not nearly so frequent as in cattle, when present in the male, they frequently take the form of gravel, which collects in the vermiform appendix, at the end of the penis. The treatment usually adopted is to remove this portion of the organ altogether

Retention of the urine in sheep causes a good deal of restlessness and arching of the back. It is said that diagnosis may be made by compressing the nostrils, which in the healthy sheep causes micturition at once, but fails to do so in the affected ones. Occasionally stricture follows operation on the urethra, in which case the animal should be prepared for the butcher.

In pigs it is best to slaughter at once; they seldom pay for treatment.

In dogs, cystic calculi are frequently present, more especially in the older animals; they can be diagnosed externally, and if the urine can be passed at all they are best left alone. Should they be located in the urethra, they may either be pushed back into the bladder with a probe or removed by operation, but stricture so often follows, and finally death, that the former operation is to be preferred.

New growths, in the shape of various forms of tumours, are frequently found in the bladder of all animals, and more rarely cancer.

As their growth is gradual, so the interference with the passage of the urine comes on slowly. Owing to the increase of size, and consequent filling of the bladder, micturition becomes more frequent, hæmorrhage may take place from them, occasionally they break down, and pus is discharged. They are diagnosed in a similar manner to calculi, from which they are easily distinguished on account of being soft or doughy to the touch.

Success in operating is usually dependent on their position, and is carried out in like manner to that for calculus; when they are situated well within the bladder, the case may be considered most unfavourable.

In females during parturition, when the vagina has been ruptured, occasionally the bladder may be pushed through, even so far as to extend beyond the vulva. The danger lies in peritonitis being set up on replacing the bladder.

Occasionally in females the bladder may be turned inside out (inversion); this also occurs during the time of parturition or soon after. The mucous membrane must be cleansed and pushed back through the urethra, either with the hand or a blunt stick, after which a warm injection of alum, five parts, water, a hundred, may be used.

In all animals it is as well to remember that diseases of the bladder are not common, although the average attendant would have us believe that they are quite frequent. There seems to be a natural tendency on their part to attribute any malady they are not able at once to understand, to the urinary organs. In horses, especially geldings, non-passage of urine may occur from such a simple cause as omitting to shake a little loose straw down in a bare stall. Because an attendant has not seen an animal pass water, that must by no means be taken as proof positive that he has not done so; it is as well to turn up the bed and make sure of the fact for yourself. [H. L.]

Bladder Campion. See CAMPIONS.

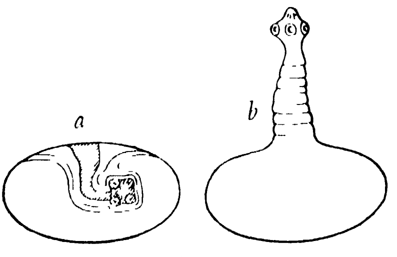
Bladder Plum. See PLUM, PARASITIC FUNGI.

Bladderworms are the larval or immature stages in the life-history of tapeworms. In other words, the eggs of tapeworms develop into bladderworms. As the name implies, the body is usually like a bladder, with a translucent wall. It contains fluid, and shows, as it develops, a minute white spot growing inwards. This white spot is the 'head' or *scolex* of the future tapeworm, and the bladder is technically called the *proscolex*.

Bladderworms were familiar long before they were known to be the young stages of tapeworms, and therefore many of them received special names. Thus *Cysticercus cellulosæ* in the pig is the bladderworm stage of the common *Tænia solium* of man, and *Cysticercus bovis* of cattle is the bladderworm stage of *Tænia saginata*, another common tapeworm in man. These two examples suggest the general fact that the host of the bladderworm is some creature that is frequently eaten by the host of the corresponding tapeworm, but there are some exceptions to this rule. Thus *Cysticercus cellulosæ* may occur in a man who has accidentally swallowed the eggs or a ripe joint of a *Tænia solium* inhabiting his intestine, and though the bladderworm of *Tænia echinococcus* is found in man, while the tapeworm occurs in the dog, it cannot be inferred that the dog eats man! In the last case the transference to the dog is effected through other hosts (usually ruminants) in which the bladderworm (*Echinococcus polymorphus*) occurs as well as in man. The important bladderworm of the sheep's brain (*Cœnurus cerebralis*), which causes 'staggers' (which see), gives rise to *Tænia cœnurus* in the dog, but it should be noticed that the same bladderworm occurs in the body cavity of the rabbit.

In most cases the bladderworm produces a single 'head' or scolex, and can thus give rise to only one tapeworm; in the Cœnurus and Echinococcus forms numerous 'heads' are produced, each of which may give rise to a tapeworm in the final host. The larval stage of the important human tapeworm, *Bothriocephalus latus*, occurs in freshwater fishes, such as pike and trout, and is quite divergent from the usual type in being solid and elongated, without any bladder. When the bladder portion is small or absent, the larval stage is called a Cysticercoid.

The development of a bladderworm may be briefly summed up. When the microscopic embryo of a tapeworm is swallowed by an appropriate host, it is liberated from its firm egg shell by the solvent action of the gastric juice; it bores its way by means of hooks out of the food canal into some other part of the body, such as the muscles, the mesentery, the liver, the brain. Coming to rest in some structure or other, it loses its boring hooks, which have fulfilled their use; it begins to absorb nutritive fluids, it grows and becomes a hollow bladder, relatively large when compared with the microscopic embryo. The common bladderworm of the pig is about the size of a pea; the bladderworm of 'staggers' may attain the size of a small orange; that of Echinococcus may be larger still. As the bladderworm develops, the 'head' arises within an in-turned bud-like growth from the wall, and the characteristic suckers destined to be the adhesive organs of the future tapeworm may be seen in process of formation, but inside out when compared with the fully formed condition. Nothing more can take place until an appropriate host eats the host of the bladderworm. If that happens, the 'head' is liberated, evaginating from within the bladder. The latter is destroyed, but the 'head' may attach itself to the wall of the intestine of the new host, and proceed to bud off the long chain of joints which form the typical tapeworm. From the eggs formed and fertilized within the ripe joints embryos develop, which may become bladderworms in an appropriate host.



a, A bladderworm (of *Tænia solium*) with the fully developed unvaginated head or scolex. *b*, The same with the head turned out.

Among the numerous bladderworms now known, the following important forms may be noted. The bladderworm of the pig (*Cysticercus cellulosæ*) gives rise to the tapeworm of man (*Tænia solium*); the bladderworm of the muscles of the ox (*Cysticercus bovis*) gives rise to another tapeworm of man (*Tænia saginata*); the bladderworm from the brain, &c., of the sheep (goat, ox, &c.), *Cœnurus cerebralis*, gives rise to *Tænia cœnurus* in the dog and the Arctic fox; the bladderworm known as *Echinococcus polymorphus* (or *veterinorum*), which occurs in ruminants, &c. (as also in man), gives rise, in the former cases, to *Tænia echinococcus* in the dog and wolf; the bladderworm *Cysticercus pisiformis*, from the liver and peritoneum of rabbit, hare, and mouse, gives rise to *Tænia serrata* of the dog; the bladderworm *Cysticercus tenuicollis* in the peritoneum of ungulates, &c., gives rise to *Tænia marginata* in dog and wolf; the bladderworm *Cysticercus fasciolaris* of rats and mice gives rise to *Tænia crassicollis* in cats, &c.; the minute larva with a small bladder which occurs in the flea of the dog gives rise to *Dipylidium caninum* (= *Tænia cucumerina* or *elliptica*), very common in dog and cat, and occasionally occurring in man; and the bladderworms common in some small freshwater crustaceans give rise to the tapeworms of ducks and other water birds. See CESTODES, STAGGERS, TAPEWORMS.

[J. A. T.]

Blaeberry. See BILBERRY.

Blanching. By excluding light from the growing parts of plants they are prevented from developing the colouring matter, more especially chlorophyll, to which green is due, and the growth is more or less elongated and less woody than it would be otherwise. The absence of light also prevents the formation of bodies to which certain flavours or even poisons are due. The common practice is to cover the parts with soil, as in the case of celery, leeks, &c., or with blanching pots, used for chicory, rhubarb, &c., or with a flat stone, as used for dandelion, endive, &c. Or the entire plant may be placed in total darkness under conditions that will induce growth, which in the absence of light will be colourless and tender. Seakale, chicory, and turnip tops are treated in this way.

[W. W.]

Blank Spaces in Woodlands almost invariably occur to a greater or less extent in all young woodland crops which have been naturally regenerated from seed shed by parent trees that have stood on the same or an adjoining area, and in all young plantations within a year or two after the plants have been set, and also very frequently in old coppices where stools have been allowed to die without being promptly replaced. To permit such spaces to remain blank must always lead to a certain amount of loss through not utilizing the productive capacity of the soil to its fullest extent, hence they should be filled or 'beaten up' as soon as they occur. In all three of the above cases the best way of filling the blanks is to plant them up with the most valuable kind of tree for which the soil and situation seem suited. Thus Oak, Ash, Elm, or Larch can usually be advantageously introduced into Beech woods on the removal of the last of the mature trees, and Larch or Douglas Fir among pines on the better classes of conifer-soil, while Birch, Willow, Poplar, or Alder may seem indicated for moist hollows, or Birch and Aspen in frost-holes where even these hardiest of trees have difficulty in establishing themselves so as to grow at all. If blanks are beaten up with a different kind of tree from that originally sown or planted, then care must be taken, if it be a light-demanding kind, to plant it of such a size that it may easily maintain itself above the surrounding crop when this closes and runs up into close canopy and the struggle for individual existence then begins among the young poles. Where new plantations are made at 4 by 4 ft. (2722 per acre) it is usually well to provide about 3000 plants per acre, so as to allow for the dying off of about 10 per cent from physiological disturbance, excessive drought or wet, insect attacks, frost, &c., and to keep this reserve-stock near at hand to replace casualties as required, unless other plants are easily obtainable from a convenient nursery. For filling blanks in coppices, the use of sturdy plants is advisable, which may be cut back when planted so as to induce the growth of stool-shoots. But it is sometimes better and cheaper to fill such blanks in underwoods by reserving strong side-shoots on neighbouring stools, and then after the fall of the coppice to plash or layer these by cutting them about half through and then bending them down to the ground, and covering them over with earth to induce the flushing of shoots from some of their buds.

[J. N.]

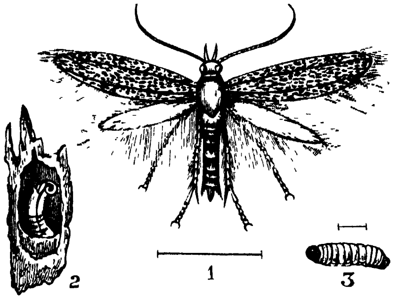
Blasting of Rocks, the operation of breaking up masses of stone or rock by means of gunpowder or other explosive. In rural economy, blasting is chiefly resorted to for the purpose of procuring road metal, or in the breaking up of uncultivated ground. The following is one of the methods in vogue. A cylindrical hole about 10 or 12 in. deep is bored in the rock by means of a chisel for the purpose. The lower part of this hole is filled with gunpowder. A straw filled with the same explosive is then inserted among the gunpowder, and the rest of the hole filled with loose sand. A match is then applied to the projecting end of the straw, and the explosion follows. It might naturally be expected that this would have no other effect than of driving out the loose sand, but it is found that the rock is effectually shattered by the explosion. A special plug, with a fuse passing through it, is also used. In extensive quarrying and tunnelling dynamite is used, and special knowledge and skill are essential.

[J. B.]

Blastodacna vinolentella (the Pith Moth), also known as *B. hellerella*, and generally in England alluded to as *Laverna atra*. Probably there is still a confusion of species.

The Pith Moth has recently been recognized as doing much harm to apple trees in England and Ireland, and probably in the past the injury done by it has very often been put down to other causes. It is a small moth of the family Tineidæ, ½ in. across the extended wings, the fore wings nearly black, the hind wings grey with a lighter fringe. It lays eggs in the summer on the shoots and spurs of apple trees, and the reddish caterpillars bore under the bark in the autumn and hide there till the spring. The shoots attacked show a blistered area with a conspicuous round hole on or near it. In the spring the caterpillars tunnel the pith of the young shoots and spurs, especially the latter, pupating in June, and emerging as moths in July.

If apple shoots are observed to be dying off without obvious cause, some specimens should be opened and the caterpillar sought for in the pith. The shoots should be pruned off and burned before the moth emerges [C. W.]



The Pith Moth (*Blastodacna vinolentella*)

1, Moth, magnified (line shows nat. size) 2, Pupa (magnified) in a shoot 3, Larva, magnified

Blatta orientalis. See Cockroach.

Blaw-weary, a Scotch name for self-heal (*Prunella vulgaris*), a common weed in damp meadows. See Prunella.

Blaze.—A term denoting a small area of a light or dark colour frequently seen on the forehead of horses. Sometimes it occupies a considerable space, forming a sort of shield over the front of the face. It varies in shape, and may be circular or oval, elongated or lozenge-shaped.

Bleaching is the name given to the process of destroying the natural colouring matters in vegetable and animal substances. The process is of immense commercial importance, and has attained to great perfection in the textile industries. Cotton, wool, and silk fibres contain colouring matters, though perhaps in small amounts, yet in the production of uncoloured fabrics they have to be removed, without impairing the strength or durability of the fibre. Previous to the bleaching, the material is first washed or scoured to get rid of substances like starch, gums, resins, albuminous matter, mineral salts, &c., which if present would interfere with the dyeing of the material later. The actual bleaching, to which the material is then subjected, is a chemical process. The bleaching agents used are either chlorine gas or sulphur dioxide gas; the former is the more powerful, and is used in the bleaching of cotton fibre, the latter for silk and wool fibres. For full information upon this subject the reader must consult a textbook on industrial chemistry, or a standard book such as Thorpe's Dictionary of Applied Chemistry. [R. A. B.]

Bleeding.—The abstraction of blood in the treatment of disease was formerly carried to extreme, and the practice has almost entirely ceased. There are, however, cases in which bleeding is desirable, and by prompt blood-letting lives may be saved. It will be sufficient to quote the two maladies known as megrims and staggers, in which immediate relief is procured by the letting of blood from a vein or from the palate.

Bleeding is undertaken for general or local purposes. If rapid depletion is desired, a large vein conveniently got at will be selected. Either of the jugular veins, which are situated in the channels of the neck, will be chosen for systemic or general bleeding, and the manner in which it will be conducted will depend upon the skill of the operator. If a cord is first drawn tightly round the neck about half-way down, the vein will be seen to fill, and distend that portion of the channel. The process will be facilitated by placing a wine cork under the cord and in the direction of the vein. An accomplished phlebotomist will then plunge a clean lancet into the vessel, and a dark stream of blood will flow so long as the cord prevents the fluid passing down its natural course. When the required amount has been taken, he will remove the pressure, seize the lips of the wound, pass a pin through them, and wind a strand of tow or other material in figure of eight around the pin, leaving it to clot and seal the wound. Next day the pin may be withdrawn and the tow allowed to fall away.

As examples of local bleeding we may take that of withdrawing blood from the angle vein on the side of the face, for the relief of eye troubles, and the abstraction of blood from the superficial vein of a hind limb (vena saphena) in cases of inflammatory œdema, of grease, and other congestions of the limb. The foot is also bled under certain circumstances, either from the coronet by punctures, or from the sole after paring away the horn. Indiscriminate bleeding is to be condemned, and better results are usually obtained by other depletive measures.

The fleam and the blood stick are still favoured in some districts, but their use oftener produces inflamed veins than puncturing with a clean lancet.

Bleeding, or Hæmorrhage.—Accidental bleeding from injuries, or as a result of surgical wounds, may require the first aid of the agriculturist, and he should be acquainted with the methods adopted to arrest it while waiting for professional assistance. It should be understood that Nature's plan of arresting bleeding is to form a clot and a plug in the divided vessel which 'corks' up the extremity. Fainting or syncope also assists by reducing the pressure of the blood stream. We have to keep in mind her methods, and apply them as best we may. In the case of large wounds in the body or trunk we cannot apply the ligature or tie anything round the parts which will arrest the flow, and must seek some other means. We will suppose a deep, lacerated wound (see Wounds) in the breast from a carriage pole, or similar accident in the quarter, where there is much muscle, and many large and small blood-vessels. We must first control the animal with twitch or hobbles or bull holder, and not wash away the blood, but seek to bring the divided skin together, unless we can see and seize the vessel which is spurting out a stream of fluid. A surgeon, provided with bulldog forceps would try to secure the vessel or vessels by pinching up the part and tying with a piece of string or a hair out of the animal's mane or tail. The amateur will not be so likely to succeed in this operation; but there are few cases in which he will not be able to save the animal if he can run pins through the skin and bring the divided edges together, and wind string or hair or fleece, coat linings or underlinen, round the pins to promote the formation of a clot. Wooden skewers, hatpins, hairpins, pieces of wire—each and all have been utilized in emergencies such as we are supposing. As the flow is less vigorous, the clot increases in size, and presently the danger is over. The animal should be kept quiet, and not walked home if a place of safety can be found. He may be allowed a good drink of water an hour after the hæmorrhage has ceased Where surgical appliances are available, antiseptics will be first employed, and styptics, as tincture of iron, tannic and gallic acid Bleeding from the limbs may be arrested by the tourniquet, as well as by the means above mentioned. With a pocket handkerchief and a short stick, one may put on such pressure as will stop the flow of blood while attempting other measures Bandaging will alone succeed in most cases, and hæmorrhage will certainly be stopped if some solution of ferric chloride or the weaker tincture of iron can be procured and poured in at the top of the bandages

Bleeding after Castration.—The operator satisfies himself that no bleeding will occur before letting his subject go free, but it will sometimes happen that the movements of the liberated animal will set up hæmorrhage of a more or less serious character. In the case of colts and bulls, we may throw buckets of cold water over the loins and dash water against the belly, with the common result of stopping the bleeding by the shock or revulsion which such treatment produces, allowing a little time before attempting any further interference. If this fails, we must secure the animal and find the severed cord, putting on a ligature, with the ends left out for removal another day If the divided cord has been drawn into the belly and cannot be secured, we may make a pack of tow dipped in solution of iron or tannic acid and stuff the scrotum, sewing it up, and allowing a large clot to form. This will arrest the bleeding, but is liable to cause other troubles (see Castration), and must be removed next day.

Bleeding after Delivery (Post-parturient Hæmorrhage).—When the young creature has been born without assistance, there is rarely any hæmorrhage requiring interference. Bleeding is more frequently the result of untimely removal of the placenta, or 'cleansing', as the investing membranes are called (see Afterbirth). Treat by cold water dashed over the loins; pressure over the chine with finger and thumb, or a surcingle twisted at top; injection of hot and cold water alternately; similar injections of tannic acid, alum, tincture of kino, catechu, or other astringents. It is rarely impossible to arrest the bleeding; but the real danger follows when an immense clot within the passage undergoes decomposition, and may poison the animal if the slightest abrasion exists in the membrane. In from twenty to thirty hours the womb should be freely irrigated with a solution of half an ounce of table salt to each quart of warm water, and cleared as far as possible of all debris. Any disposition to fresh hæmorrhage may then be prevented by a weak solution of alum. The animal should be allowed abundance of water, and in it should be dissolved some bicarbonate of potash to the amount of about 2 oz per diem for a cow, and so on in proportion to the size and species of the animal. A disinfectant such as 2 or 3 per cent carbolic acid will be advisable if the contents of the womb have become fœtid Tonics, as iron and gentian, are calculated to restore the patient.

[H L]

Blemish.—Besides the general meaning of the word known to our readers, there is a particular application of it to horses. The presence of a patch of hair of unusual colour, the loss of a horn from a beast, or baldness of any part of the animal will be deemed a blemish in the ordinary language of the stock-owner; but the horseman uses the term almost exclusively with reference to the knees of an animal that has been down, or to one injudiciously blistered, or to the marks of the firing iron. Blemish means a permanent disfigurement depreciating the value of the animal [H. L.]

Blended Butter.—The term 'blended butter' is applied in two senses. Different classes or qualities of butter are blended together to secure uniformity in taste, colour, and texture, and this operation is quite legitimately termed blending The term is also applied to the incorporation of milk, cream, water, condensed milk, milk powder, fresh or condensed whey, sugar, glucose, margarine, neutral fats, and other substances with butter to fraudulently increase the bulk, or to improve the taste of an inferior article. By the Butter and Margarine Act, 1907, the sale of a blend of milk and butter is made legitimate, so long as it is sold under an authorized fancy name, and does not contain more than 24 per cent of water.

In butter factories the butter received from the various markets is graded by experts, and mixed in large quantities by blending machines. These consist of cylindrical vessels, open at one side and placed horizontally, in which a series of arms of carefully calculated design revolve in contrary directions, and which thoroughly mix the contents. Usually a small addition of water—partly to replace that worked out of the butter, and partly to increase the percentage to an amount below the allowable limit—and of preservative is made to the blend. The operation is only carried so far as to ensure thorough incorporation, with as little damage to the grain as possible.

By blending butter in large quantities an almost absolutely uniform product can be obtained, even if the original butters differed widely in their characteristics; and the product is much more marketable than the different parcels would have been had each been sold separately. By suitably varying the proportions of pale and high-coloured butters, or of butters which are tasteless or of high flavour, a product which is uniform from day to day can be ensured. [H. D. R.]

Blennocampa, a genus of sawflies. *B. pusilla* is the Black Sawfly of the rose, especially attacking *Rosa canina.* The injury done by its larva is very characteristic, the rose leaves rolling up cylindrically. It occasionally does much damage to garden roses, and is probably introduced when brier stocks are planted for standards.

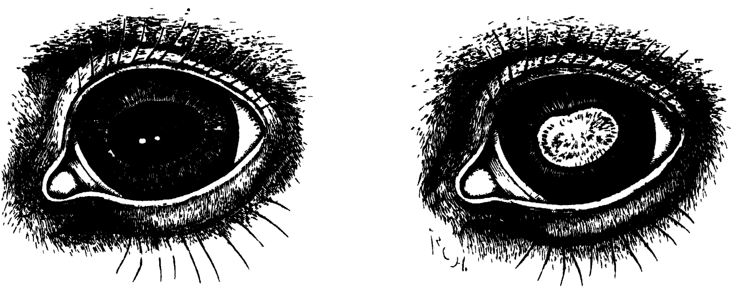
The green caterpillar-like larvæ are found under the curled leaves in early summer, and are fully fed in August, when they conceal themselves in the earth, pupating in the following spring.

Treatment.—Destroy the curled leaves with the enclosed larvæ. Wash the roots of brier stocks before planting them in the garden. [C. W.]

Blickling Cattle. See Wild White Cattle.

Blinders. These are distinguished from blinkers, as being contrivances by which the animal is precluded from seeing at all. Veterinary surgeons employ them in performing minor operations, when it is desired to conceal the intentions of the operator in part and to restrain the animal from going forward. Blinders with suitable padding are also employed when casting horses for firing or other performances, and are then used chiefly to protect the eyes from injury. In the case of some horses with imperfect vision and confirmed in the dangerous habit of shying, blinders so-called are the only means of rendering the animal safe to use upon the road. They usually consist of a wide band of leather or other material having attachment on either side to the harness blinkers in common use. The horse thus driven is not absolutely blinded, but has a limited vision of the ground immediately in front of him, while unable to see those objects which frighten him, because they are not correctly focused. [H. L.]

Blindness.—In the lower animals, blindness is most commonly met with in the horse and dog, although any of the domestic animals may be affected. Sheep occasionally suffer from an epidemic of temporary blindness, caused by the seeds of certain grasses being blown into the eyes while grazing. Many causes, such as blows, injuries, scratches, bites, irritating vapours or chemical substances like strong acids reaching the eyes, may result in blindness, either temporary or permanent, but in the horse the two chief factors in producing this condition are 'cataract' and 'specific ophthalmia'.



Partial Cataract Complete

As in the human family, there can be little doubt that blindness is often an hereditary affection in the lower animals, and this is very noticeable in the horse and dog; hence it is important to recognize this fact when breeding, and avoid animals with defective eyesight, unless it can be demonstrated that the condition is the result of some accidental cause, and not associated with either of the two diseases previously mentioned.

Cataract.—The term 'cataract' means a diseased condition of the eye in which the crystalline lens, instead of being clear and watery, shows white specks in its substance, or is entirely converted into a pearly white body. The crystalline lens is a biconvex disk which lies just inside and behind the pupil. It is covered by a thin capsule or skin, and its function is to focus the rays of light entering the eye and transmit them backwards. According to whether the cataract develops on the capsule or in the substance of the lens, it is termed capsular or lenticular cataract.

In the early stage of the affection it is impossible to detect the condition without professional skill and the use of an instrument called an ophthalmoscope, and with this can be observed one or more small white specks, which as time goes on increase in size until they become quite visible to the naked eye of the observer, and ultimately may affect the whole surface of the lens, giving to the centre of the eye that characteristic milky-white appearance so typical of the disease. A common symptom in the horse, during the early stages of cataract, is a tendency to shy at small or imaginary objects, and this must always be regarded with suspicion.

One of the chief features of cataract is that it is usually an insidious affection, and is not associated with painful symptoms; so that, unless it is very marked, it may, and often does, escape detection; and it must be obvious to all that the eyes of stallions should be examined at shows, to prevent, as far as possible, perpetrating this undoubtedly hereditary affection.

Occasionally cataract is not hereditary, but is the result of severe injury to, or inflammation of the eye; but these cases are comparatively rare. Medicinal treatment is of little avail; but it has been proved possible to surgically remove the diseased lens and replace it by an artificial one, as is done in the human subject, and partial recovery has been recorded in the dog, even when the latter part of the operation had been omitted.

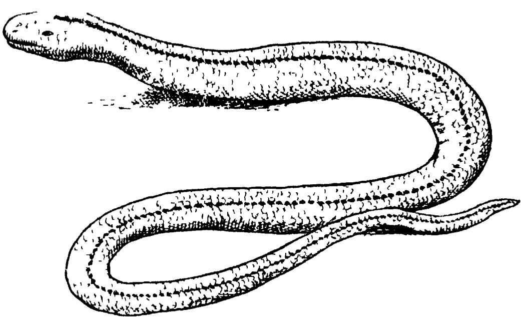
Specific Ophthalmia, or 'specific inflammation' of the eyes, is a disease which undoubtedly is much less frequent than it formerly was. It used to be popularly known as 'periodic ophthalmia' or 'moon blindness', because of its tendency to recur at intervals. This affection consists in a severe and painful inflammation of the eye, involving both the superficial and deep structures of the organ One or both eyes may be simultaneously attacked Tears flow from the swollen eyelids, and there is great intolerance of light, the eyes are red and congested, and if we look deep into them we find the healthy, clear colouring replaced by a general ambergrey dimness After a few weeks the disease gradually abates and the eye clears up, only to be followed by a second and worse attack later on, until ultimately one and then generally the other eye becomes blind At this stage there is usually to be observed a peculiar puckered, drawn appearance of the upper eyelid, instead of being elliptical in shape, the lid becomes more triangular and drawn up in the centre, giving a peculiar careworn expression to the features.

Treatment, beyond soothing the pain by allaying the inflammation during the severe attacks, cannot be regarded as of much avail in staying the advance of the disease, and of course the animal should be kept in a darkened loose box

The cause to which the affection was formerly attributed, *i e* badly ventilated, dark stables and irritating gases, can hardly explain its presence, and the fact that other animals constantly exposed to the same conditions escape, throws considerable doubt on the once accepted explanation Undoubtedly heredity plays an important part in the propagation of this form of blindness, which happily is becoming more rare in Great Britain [J R. M'C]

Blind Teats.- Teats which are imperfectly formed or fail to yield milk are commonly spoken of as 'blind'. Strictly speaking, the term should only be applied to such as have no opening. This but rarely occurs, and is irremediable. Imperfect apertures, or those endowed with too strong sphincters are not rare, and these by judicious dilatation may be rendered serviceable and garget prevented. A variety of probes and teat dilators are made for the purpose, and answer very well in the hands of experienced persons, but their rash employment by unskilled hands is liable to result in injury which causes paralysis and permanent leakage, or a cicatrix which leaves the orifice constricted. [H. L.]

Blindworm, or slowworm (*Anguis fragilis*), a limbless lizard with a snake-like body, not uncommon in some parts of Britain. The popular name 'blindworm' is misleading, for the eyes are well developed; and the popular impression that the creature is poisonous is equally false. The blindworm is absolutely harmless, and feeds chiefly on earthworms and slugs, sometimes also on insects It is often swallowed by the adder. The length of a mature blindworm is usually about 10 in , but specimens a foot long are not uncommon, and there is a giant of 17 in in the British Museum. The tail occupies towards half of the whole length. As in many lizards, the colour of the body is very variable, but it is usually greyish-brown above and blackish-brown below, with a metallic sheen all over. The very young are silvery-white above, with a median line and two more lateral lines of deep-black. In some cases the dark median line persists throughout life Old specimens sometimes show blue specks. The cylindrical body is covered with small, closely fitting, roundish scales, and below these there are thin bony plates in the dermis or underskin. When captive specimens moult, the slough comes off in separate pieces, but in natural conditions the slough coheres as in snakes, being turned inside out from the head backwards, and left entangled in the brushwood In his British Reptiles (1849) Bell notes that in some cases the slough is said to be inverted only as far as the anus, the tail slipping out of its covering 'like a sword out of its scabbard'. There is a very minute ear-opening, almost hidden by scales The teeth are fang-like and curved backwards The tongue seems to be partially retractile into its broader basal part; it is notched in front, not bifid like a snake's.



Blindworm (*Anguis fragilis*), about ¾ nat size

It may be useful to point out that, apart from the absence of limbs and the general shape of the body, the blindworm has no close resemblance to a snake Without going into details, we may note that the two types are quite different as regards skull, ribs, scale arrangement, and soft parts Moreover, the blindworm has always a vestige of the pectoral girdle, which snakes never have; it has always a vestige of the pelvic girdle, which is very rarely represented in snakes (boas and pythons), it has a long tail, whereas snakes have a relatively short tail; and it has movable eyelids, which are quite rudimentary in snakes. The slight superficial resemblance to snakes is technically called convergence — a similar adaptation to similar conditions of life, such as creeping among brushwood and through crevices. A convergence to snake-like shape is seen in some other limbless lizards, some nearly related to the blindworm, and some belonging to quite different families. It is also seen in the limbless burrowing Cæcilians (sometimes also called blindworms), which belong to the class Amphibia.

There are many interesting peculiarities in the structure of the blindworm. Thus we may refer to the minute bony plates below the scales, and to the 'parietal organ' which arises in connection with the median pineal upgrowth from the brain. It has some traces of eye-like structure, and is apparently a sensory organ possibly sensitive to changes of temperature. A well-known physiological peculiarity is suggested by the specific name *fragilis*, which refers to the fact that the blindworm is liable to break in two. When captured it becomes rigid, with strongly contracted muscles, and a slight twist suffices to break off the tail. This surrender of the tail is common among lizards, and there can be little doubt that it often saves the animal's life. What is lost can be subsequently regrown if the mutilated blindworm escapes.

The blindworm is a shy, timid creature. It is active during the day, especially, perhaps, towards dusk; it prefers shady places, especially when it is young. At night it hides under moss or stones, or in the ground. In autumn a number—as many as twenty it may be—retreat together into a common burrow in some warm, dry place. There they remain throughout the winter, emerging again in spring. The pairing takes place in May. From eight to twelve young ones are usually born at a time, in the month of August or September. As the soft-shelled eggs are laid they burst and liberate the fully formed young, so that the animal is practically 'viviparous'. The newly born little creatures are about 1½ in. in length, they double this in about six weeks; but they take four or five years to become full-grown. The blindworm is a hardy animal and occurs all over Europe and in Western Asia. It is the only species of the genus *Anguis*, and belongs to the widely distributed family Anguidæ, which has representatives in North America, India, and North Africa, including, for instance, the 'glass-snake' (*Ophisaurus apus* or *Pseudopus pallasi*)— a snake-like, brittle lizard about a yard in length, which occurs in South Russia, Asia Minor, and Morocco. Blindworms should never be killed. They destroy large numbers of slugs, such as *Limax agrestis*, and do far more good than harm. Their bite is not strong enough to draw blood.

[J. A. T.]

Blinkers, the prominent side pieces of a horse's bridle, whose intention is to limit his field of vision, and direct his attention to objects in front of him, while restraining curiosity in other directions. This adjunct to harness of almost every kind has met with the approval of horsemen for generations, in the belief that the animal pays more attention to his work, and is less liable to stumble on stones or be diverted by objects which should not concern him. They are often attached to exercising bridles, but rarely to riding bridles, and many persons are of opinion that they are not necessary, and even fatiguing to an animal, who would take more interest in a journey if able to look about him. Some of the largest studs of draught horses in London and other great cities are driven without blinkers, and carriage horses may be seen without them. Like the bearing rein, they constitute part of the furnishings of harness to which we have grown accustomed, and without which there is a loss of smartness in the general appearance of a carriage horse.

[H. L.]

Blisters and Blistering. —The tyro in veterinary matters is struck with the frequency with which blisters are prescribed for the lower animals, and may with advantage consider the reasons for such practice. Blisters or vesicants are employed in the treatment of inflammatory diseases of the organs, with a view to promoting a counter-irritation and withdrawing to the surface an excess of blood which is doing injury within. That Nature cannot support at one and the same time two inflammatory processes in close proximity is the view held by those who advocate vesication in such maladies as pneumonia or congestion of the liver. There are eminent scientists who dispute this opinion, but the great majority of practitioners of veterinary medicine believe strongly in the value of such treatment. With regard to the limbs, there is a consensus of opinion as to the propriety of blistering for the cure of various forms of lameness, as experience teaches us that the after-effects of a suitable vesicant promote absorption of morbid deposits in the tissues, and arrest the deposition of bony material if they do not actually cause its absorption. For the sides of the chest, to the throat, and other parts of the body, mustard mixed with warm water or vinegar, or 'sharpened' with a little spirit of turpentine, is recommended, and care must be taken to prevent the animal from rubbing the parts and injuring the skin. Blisters for broken-down tendons, splints, spavins, ring bones, and other ossific troubles are more commonly composed of biniodide of mercury and lard or vaseline. One part of the former to 7 or 8 of lard or vaseline is suitable for adult animals of mixed breed, but for racehorses or colts with fine skins the proportions will be 1 to 10 or 12; using the latter where it is intended to repeat the operation at no distant time.

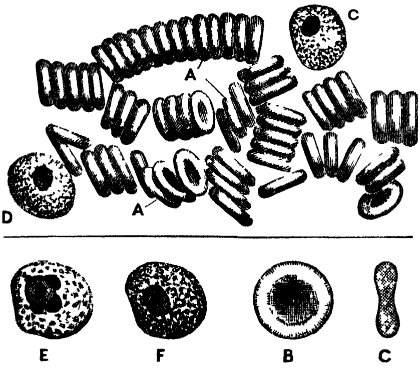
When applying blisters to the legs of horses it is necessary to clip the hair closely to obtain the full effects and economize material. To prevent the patient injuring himself while smarting under the effects of the blister, he must be secured on both sides to the pillars of the stall in which he is confined. Double halters should also be used—not chains, which may snap—and he should remain tied up for twenty-four hours, being fed from a basket or nosebag. Neglect of these precautions may lead to serious injuries, caused by the horse rubbing his eyes or mouth against the suffering member. The humane instinct to soften the blistered limb with soap and warm water is generally yielded to, but the ultimate results are probably better if the hard caked matter is allowed to remain on and exert a certain degree of pressure—pressure which is known to promote absorption.

[H. L.]

Blith, Walter, one of the most shrewd and advanced of the early English writers on Agriculture, whose books were published in the times of Charles I and the Commonwealth. Blith is remarkable for having been the first writer in this country to give scientific explanations of land drainage, and for having been the earliest public advocate of tenant right. In 1641 he published The English Improver; or A New Survey of Husbandry; and in 1649 he brought out The English Improver Improved, or the Survey of Husbandry Surveyed. A second edition of the latter enlargement upon the earlier work, published in 1653, was dedicated to 'The Right Honorable the Lord Generall Cromwell, and the Right Honorable Lord President, and the rest of that most Honorable Society of the Council of State.' In the dedication Blith pleads earnestly for security to tenants for their improvements (see art. TENANT RIGHT). In an 'Epistle to the Industrious Reader' the author exhorts him to 'study Improvements, which though they may not be said to be either Father or Mother to Plenty, yet it is the Midwife that facilitates the birth.' In a quaint address to 'the Husbandman, Farmer, or Tenant', Blith finds fault with too great a trust in frequent ploughings merely, and with too strong a disposition on the part of farmers to take more land than they can do justice to. His views on land draining are sound, and remarkably advanced for his times. He advocated, not only the draining of wet fields by individuals, but also general schemes of drainage, to be carried out by all the landowners in a district.

[W. E. B.]

Blood.—In every animal organism of any size, only a relatively small number of its cells can come into actual contact with the foodstuffs of the animal. Hence all the other parts of the body must gain their food through the intermediation of these more favoured cells. The carrying of this food material from the absorbing surface to the various tissues is effected by a circulating medium, which is the *Blood*. The foodstuffs comprise not only those absorbed from the alimentary canal, but also oxygen taken in by the lungs. In the second place, the waste products produced during the life of each cell are discharged from it and at once, or ultimately, are carried into the blood. By this vehicle it is conveyed to that tissue where it is to be destroyed or discharged from the body. Thus the two essential rôles played by the blood are the carrying of food to the tissues and of waste products away from the tissues. But in addition this same circulating medium is utilized for the carrying of substances from one tissue to another—chemical bodies manufactured in one organ and carried to a second for its nutrition or its excitation. Such are the internal secretions of the ductless glands or the hormones, *e.g.* of the intestinal mucous membrane. Recent advances in pathological knowledge have shown us yet another work performed by the blood in distributing chemical substances (anti-bodies) capable of neutralizing toxic materials (bacterial toxins, ferments, &c.), or of paralysing or killing living micro-organisms. Lastly, we must remember that the blood also contains living cells, leucocytes, of various types, most possessing one typical property, that of acting as phagocytes or scavengers, of ingesting or eating up debris of tissues, dead cells, micro-organisms, &c. The blood thus being of such important service in the body, and being always retained within vessels which at any time are liable to injury, a special provision is made to minimize any loss that may occur through the accidental cutting of a small bloodvessel. For this end the blood is able to clot, *i.e.* to set into a firm jelly, thus plugging the severed vessels if they be of not too great a size. Bearing these various works in mind, the chemical constitution and morphological characters of the blood receive their full explanation.



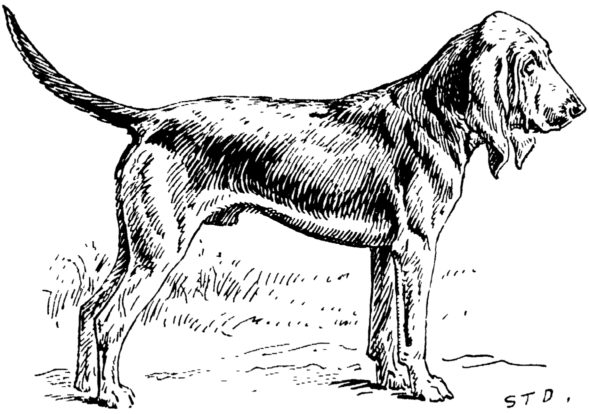
Blood Corpuscles

A, Coloured blood corpuscles adhering together in columns (rouleaux). B, Coloured corpuscle, showing concave surface. C, D, E, F, Colourless corpuscles.

Microscopically the blood is seen to consist of a large number of formed constituents, the *corpuscles*, suspended in a clear fluid, *plasma*. Chemically the plasma is found to contain a number of proteins (from 6 to 8 per cent in different bloods), a carbohydrate, dextrose (0·1 to 0·2 per cent), salts, a large number of organic bodies, each present in small amount, and water. The proteins present consist of albumins and globulins in approximately equal amounts. One of the globulins, fibrinogen (0·4 per cent), yields when acted upon by a ferment (thrombin) a solid protein in the form of fine threads (fibrin), and it is this precipitation which effects the solidification of blood in clotting. Thrombin is not present in living blood, but is only produced when blood is shed, probably from the white blood corpuscles or the platelets. The proteins are to be regarded, in the first instance, as food-stuffs for the tissues. Of other foods there is dextrose, and at times fat in the form of very minute globules. As instances of waste products may be mentioned carbonic acid (about 40 c.c. of gas in about 100 c.c. of plasma) and an extensive group of nitrogenous bodies, *e.g.* ammonia, urea, creatin, uric acid, the purin bases (xanthin, hypoxanthin, adenin, &c.), hippuric acid, amino acids, &c. All these latter are only present in quite small amounts. Of other carbon compounds may be mentioned glycerine, cholesterine, and lecithin.

The corpuscles are of two kinds, the red and the white. The red corpuscles of the mammal are small non-nucleated biconcave disks with bevelled edges. They are present in vast numbers, 4,000,000 to 5,000,000 per cu. mm. By virtue of the hæmoglobin they contain they act as oxygen carriers from the lungs to the tissues. The white corpuscles are nucleated cells of several types, most of them possessing amœboid properties. Several collect granules within their cell protoplasm, which probably represent a store of material that can be quickly discharged as required as a secretion. Such secretions are known to be capable of paralysing, even of killing living micro organisms, and it is probable that they may possess other properties. By their amœboid powers they act as phagocytes, flowing round and engulfing solid matters which may have gained an entrance into the tissue spaces. If the enclosed matter is proteid in nature it becomes digested, the phagocyte producing intracellularly a digestive ferment. In such a manner disintegrated cells, red blood corpuscles, or micro-organisms may be removed from these spaces. The leucocytes also show another distinctive property, that of chemotaxis. This is the property of being attracted and moving towards a certain area in response to the stimulus of a chemical substance which is being produced at that area. In this manner the collection of leucocytes in inflammatory areas is effected. [T. G. B.]

Blood Horse. See THOROUGHBRED.



Bloodhound

Bloodhound.—Although the Bloodhound is very properly classified as a British breed, there is no doubt that his existence is due to a foreign source, or that he is a descendant of the famous St. Hubert hound of France. The two varieties have in fact been interbred within the past few years by some breeders, to the benefit of their strains, as the points of difference that exist in their appearance are so few that complete success attended the experiments which were made. The Bloodhound unfortunately, as is the case with other valuable breeds, exists under the great disadvantage of having his disposition misunderstood by a very large number of people. Probably it is owing to the name he possesses that the public have become so much in the habit of regarding him as a most ferocious animal, whereas if the truth be told he is nothing of the sort. No doubt some specimens of the breed are uncertain in their tempers, but the majority of bloodhounds are amiable enough; and at all events there is no doubt but that the breed has derived its name from its marvellous scenting powers, which has caused it to be utilized in every part of the world for tracking criminals.

Many remarkable accounts, some of them well authenticated, have been received regarding the extraordinary performances achieved by trained bloodhounds in following up a trail, and it may be within the memory of those who read these lines that a hound of this breed was instrumental in bringing the murderer of a little girl to justice in the north of England. Of late years there has been no established pack of bloodhounds in this country, with the exception of that possessed by the late Lord Wolverton, which was disposed of some little time ago. The owners of smaller kennels, however, have recently been devoting attention to the training of their hounds, and with excellent results, as the success of the public trials which took place was attested by the Earl of Lonsdale, who officiated as judge at one of them, his lordship speaking very highly indeed of the staunchness displayed by the competitors in following out the trail. As a general rule, however, the owners of bloodhounds do not attempt much in the way of entering their hounds at any sort of game or even of training them to hunt a line, and hence the powers of many a valuable animal are not developed as they otherwise would be, but still the possession of a remarkably acute faculty of scent is not denied to them.

In appearance the Bloodhound is perhaps the most picturesque of all breeds; his narrow skull, of which the occipital protuberance is developed into a most pronounced peak, being entirely different from that of any other dog. The beautifully chiselled muzzle, with its deep flews, the deeply sunken eyes showing the red haw in the inner corners, the gracefully pendulous ears of extreme length, the heavy wrinkling on the brows, and the superfluity of loose skin of the very finest texture which adorns the whole head, all combine to add to the majestic appearance of this truly noble-looking variety. The powerful neck is placed at a graceful angle on the very best of shoulders, the body is of immense depth, being very much let down behind the forearms, the loins are well ribbed up, and indeed the back and middlepiece of the Bloodhound display more power than could be expected even in a dog of his proportions. As in the case of all hounds, particular importance is attached to the fore legs, as any weakness or absence of symmetry here is a most serious fault. The legs should be of fair length and absolutely straight, the slightest inclination to be out at shoulder or in the least degree crooked at the pasterns being regarded as a disqualification. They should also be very heavy in bone, and the feet must be large, round, compact, and very thick soled. In fact a Bloodhound should be selected as much for his legs as for any other point, for a hound that is incapable of displaying agility or moving fast is useless for the purposes for which he is bred. The stern, or tail, should be coarse, and is carried rather gaily, whilst the hind quarters must be muscular, and the legs of good length from the stifle joints to the hocks, the latter being rather close to the ground. The coat of this breed is much harsher to the touch than it appears to be, and is dense enough to protect its possessor from the weather no matter how severe it may be, but it may be added that the Bloodhound in his infancy is a delicate variety, being a ready victim to distemper, which affects the whelps very seriously, probably by reason of the fact that owing to the variety being in so few hands the existing strains have been a good deal too much inbred, with the result that constitutions have become more delicate. The orthodox Bloodhound colour is a rich golden tan with a black saddle on the back, but occasionally a whole-coloured tanned specimen is met with, but such are not liked. About 100 lb is a good average weight for a Bloodhound, the specimens of the gentler sex being a little lighter than the males.

[V. S.]

Blood Manure.—This, as its name implies, is a manure which is produced from the blood of animals slaughtered at large abattoirs. Its most valuable manurial ingredient is nitrogen, the amount present depending chiefly on the process adopted in its manufacture. See NITROGENOUS MANURES.

Blood Poisoning.—A very wide significance attaches to the above term, since all the specific diseases, as glanders and strangles, are due to the entrance into the blood of a particular septic germ or poison; but for convenience, and in the present connection, we propose to consider those disorders of the blood more commonly understood by the non-professional reader; referring him to specific diseases for an account of those blood disorders which lead to strangles, swine fever, and other well-known maladies, dependent for their manifestation upon the invasion of the blood by a poison of a special character.

SEPTICÆMIA, OR SEPTIC POISONING.—When blood poisoning results from the entrance of bacteria into the circulation, it is termed septic infection. The disease may be communicated to a healthy animal by inoculation. Bacteria are then the direct inducing factor. Chemical poisons formed by certain bacteria, as those of putrefaction, may induce septicæmia. Decayed tissues in wounds are among the common causes of blood poisoning. When these bacterial products are absorbed into the blood the animal is said to be suffering from septic intoxication, but this form is not transmissible by inoculation of the blood into a healthy subject. *Pyæmia* is a form of blood poisoning in which pus is produced, as in the abscesses which follow upon neglected wounds in joints. The reader is recommended to look up the subject of NAVEL ILL and JOINT ILL so called, as well as those diseases of the blood dealt with elsewhere.

Blood poisoning, in whatever form, must be regarded as serious, and extremely liable to cause the death of the victim. One or more shivering fits may usher it in. Accompanying these rigors there is rise of temperature, hurried respiration, quickened but enfeebled pulse, and much prostration. Appetite is lost; the visible mucous membranes of the eye and nose have a yellowish red appearance, and in some cases show spots or blotches of blood upon them, the tongue is furred, and coated with clammy mucus. These symptoms are common to septicæmia and pyæmia, but in the latter there is the additional disposition to the formation of abscesses, either on the surface, in the glands, or the internal organs. Abscesses in the joints occur as a result of pyæmia arising out of injuries to the limbs, or may be caused by infection in other and softer structures. The brain, the lungs, liver, or kidneys may be the seat of these abscesses, and the symptoms will vary accordingly. Mania or stupor may be prominent in brain cases, difficult respiration and symptoms of pneumonia when the lungs are the seat of abscess, and arching of the back and more or less paralysis when the kidneys are involved. The effects of pyæmia are more enduring than those of septicæmia but not more destructive, according to Professor Axe.

Treatment—When due to a poisoned wound it is obvious that our first efforts must be directed to disinfecting the source, and thereby arresting the supply of morbid matter. In quite the majority of cases blood poisoning is due to neglect of the employment of antiseptics. The prick from a rusty nail, or wound from a barbed-wire fence or dirty stable prong is not deemed so dangerous as it should be. The poison is allowed to remain, and disease germs to multiply, when it would have been easy at first to irrigate the wound and neutralize their work, or render it unattractive to the invaders, which in many cases enter after the injury is done.

One-per-cent solutions of lysol, or 3-per-cent of carbolic acid, form suitable lotions for injection into injured tissues; a moderate degree of force from a soft-nosed syringe or enema pipe being desirable. In addition to such local treatment, and where the cause is not directly traceable to an injury, the system, suffering as it is from shock, should be upheld by stimulants and tonics, as brandy and quinine, the latter seeming to have a special controlling effect upon the red blood corpuscles when disposed to disintegrate Nourishment in the form of eggs and milk may be horned down if appetite is entirely suspended, and the patient placed in pure fresh air, in a box with a cheerful aspect

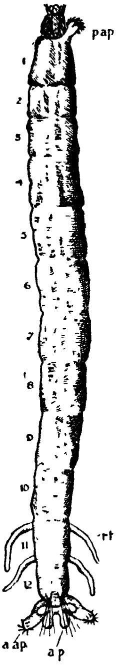
[H. L]

Blood Spavin consists in a swelling of the internal saphena vein in its course over the front of the hock; it is not in itself a disease, and may be the result of pressure above and below. In bad cases it is unsightly, but it never causes lameness It is not an unsoundness, and does not require treatment [H L]

Bloodworms, a popular name for the blood-red larvæ of the Harlequin Fly (*Chironomus dorsalis*) They are often found in the mud of slow streams or in stagnant pools, where they feed chiefly on decaying vegetable matter They usually avoid the light, making tubes in the mud or covering themselves with roughly made sheaths These sheaths are made of pieces of dead leaf held together by viscid threads of salivary secretion, or of particles of sand or mud similarly bound together The head end is protruded out of the tube or sheath in search of food, at other times the hind part is protruded and swayed up and down in the water The undulatory movements of the body serve to change the water within the tube or sheath. Professor Miall notes that 'the larva, if undisturbed, seldom or never leaves its retreat by day, but at night it ventures out and swims near the surface of the water, writhing in figures-of-eight The body is violently doubled up, and then suddenly bent to the opposite side, and the blows thus given to the water propel the larva slowly along During these nightly excursions a store of oxygen is obtained, which amply suffices for the following day, when the helpless larva dares not quit its shelter.'

The bloodworm is nearly an inch in length The body consists of a small strongly armoured head and twelve segments, of which the first three correspond to the thorax of the fly On the first segment behind the head there is a pair of stump-like claw-bearing limbs, and on the last segment of the body there is another pair of limbs The head bears small antennæ and three pairs of jaws The tracheal respiratory system is very poorly developed, and there are no external openings or spiracles On the other hand, two pairs of 'blood-gills' occur on the last segment but one, and another two pairs, much shorter, on the last segment close to the anus These 'blood-gills' are thin, flexible, mobile extensions of the body wall, and show an in-and-out pulsation of blood With a lens or a low-power microscope some of the other organs of the bloodworm may be readily observed; thus the heart may be seen beating, and the intestine contracting and expanding. The red colour of the blood is due to the same pigment, hæmoglobin, that occurs in backboned animals. Its importance lies in its power of entering readily into loose union with oxygen absorbed from the water.

The eggs of the Harlequin Fly are laid in cylindrical gelatinous masses, which are fixed by the female to some stem or the like by the water's edge. They hatch in three to six days, and the fresh-hatched larva has at first no red colour. As the young larvæ grow, they moult their cuticle several times When they are nearly an inch long the rings behind the head become swollen, and the larva passes into the pupa stage Inside a delicate transparent envelope there is a metamorphosis, resulting in the formation of the fly—with a pair of wings, three pairs of long legs, and a relatively large head with compound eyes The pupa is well marked by a fringed tailplate and by bunches of thread-like tracheal gills behind the head After lying quiet, without feeding or swimming, for some days, the pupa becomes buoyant and rises to the surface of the water, where the pupa skin splits and is cast off. The Harlequin Fly extricates itself with astonishing rapidity and takes wing. Professor Miall notes that in the case of a fly which escaped more slowly than usual, the whole process occupied ten seconds!



Bloodworm, larva of *Chironomus dorsalis*, much magnified The numbers 1-12 indicate the segments of the body, beginning at the head end

p ap, Prothoracic appendages *rt*, Ventral blood gills *a ap*, Anal appendages *a p*, Anal blood gills

Bloodworms may be found nearly all the year round. Those found in winter usually pupate and turn to flies in early spring. There is generation after generation of flies throughout the warmer part of the year until late autumn The Harlequin Fly is a gnat-like midge, from 5 57 to 7·5 mm in length. It is often seen in huge swarms, mostly males, dancing over the streams and pools in the summer evenings. The males can be distinguished from the females by their large plumed antennæ and by their larger eyes. The flies do not seem to feed at all; they have not the biting or piercing organs of gnats, and they are, of course, quite harmless.

There are numerous species of Chironomus besides the common Harlequin Fly, *Chironomus dorsalis*, but the term 'bloodworm' is applied only to the blood-red larvæ of one group of species. The typical 'bloodworm' is relatively large, and has long 'blood-gills'; the pupa bears tracheal gills in the form of long filaments, and has a fringed tailplate. In the other group of larvæ, which are not always red, the blood tubules are absent, and the pupa has a pair of short breathing trumpets instead of filaments, and a tailplate with two bunches of short bristles. Technically, the genus Chironomus belongs to the family Chironomidæ, in the suborder *Orthorrhapha nemocera*, in the order of Diptera or two-winged flies. There are said to be about 200 species of Chironomus in Britain.

It cannot be said that bloodworms have much economic importance. They are scavengers in the mud, they are devoured by many aquatic insects and also by fishes; they comprise numerous parasites, especially Gordian worms. This article is based on the altogether admirable monograph by Professor L C Miall and Mr A R Hammond (The Harlequin Fly, Clarendon Press, Oxford, 1900) [J. A T]

Bloody Flux.—In old works on farriery, dysentery is usually intended when this term is employed, but ancient writers on human maladies sometimes referred to sanguineous discharges of other kinds It is now generally understood to apply to a form of bowel discharge in which mucus and blood are mingled, as the result of continued and excessive purgation due either to specific disease, as cattle plague, when patches of the lining membrane of the bowels are detached and a bleeding surface left, or as the result of intestinal tuberculosis, of irritant poisoning, or the persistent infectious diarrhœa of calves Bloody discharges from the intestinal canal must always be regarded as serious, and prompt measures resorted to in order to arrest them, or the animal soon succumbs The treatment will depend somewhat upon their cause and origin, and it may not be worth while to attempt remedial measures if due to those specific infectious disorders above mentioned In others we may administer stimulants to uphold the sinking animal, whose temperature is probably sub-normal, and astringents, such as opium, chalk, bismuth, oak-bark infusion, injections per rectum of starch, and drench the patient with whites of eggs, with arrowroot, and other nutritious foods of the kind See DIARRHŒA [H L.]

Blown or **Hoven.**—Blown, blast, hoven, are names given in different districts to a condition of the rumen or paunch when distended by gases; technically termed tympanitis. The acute form is caused by eating to excess of green foods of a watery nature Animals that have been confined in yards during the winter will, when first let out into rich pasture, partake too freely and eat too fast, with the result that the food undergoes fermentation in the first stomach, and immense distension follows, endangering the animal's life by the pressure upon the diaphragm and respiratory organs. When young stock break into clover, a fatal result is often extremely rapid, and some of them are found dead before their trespass has been discovered. Treatment must be prompt. The left flank, midway between the last rib and the hip, must be boldly punctured in order to allow the accumulated gas to escape. The proper instrument is a trochar and canula, but in an emergency a piece of metal piping or an elder stick from which the pith has been removed, may be made to do until professional aid can be obtained. No time should be lost in giving a copious draught of linseed oil, as this masks the gases to a great extent, and indeed often cures without puncturing the flank. Stimulants should also be given, such as spirits of nitrous ether, or alcohol in any of its popular forms When the first urgent symptoms have passed it may be necessary to treat the animal for indigestion (which see). Chronic hoven is due to indigestion, and occasionally to some mechanical obstruction, and is most likely to be combated by special selection of food, and such remedies as will be found recommended for digestive difficulties (see art. INDIGESTION). [H L.]

Blubber Manure consists principally of the flesh of the whale and other fish offal mixed with soil, ashes, &c After allowing such a mixture to decompose in a heap, the rotted material is used as a manure The principal use, however, of blubber is for the purpose of extracting train oil The presence of oily material in a manure would make it of a very slow-acting nature The manurial value of blubber manure is derived mostly from the combined nitrogen it contains, and from its richness in carbonaceous matter [R A. B]

Bluebell (*Campanula rotundifolia*)—The 'bluebell of Scotland' belongs to the nat. ord. Campanulaceæ, remarkable in three points the juice is milky, the ovary is on the outside of the flower, and the stamens are not attached to the corolla The Bluebell is a perennial herb about 1 ft high which grows on dry, sandy banks and heaths. The stem bears two kinds of leaves those down on the ground, which are round and die away early, and those up on the stem, which are exceedingly narrow. The flowers have a graceful droop, and though usually pale-blue are sometimes white. In England this name is commonly given to the Wild Hyacinth (*Scilla nutans*) [A. N. M'A.]

Blueberry. See BILBERRY.

Blue Cheeses.—There are many kinds or makes of cheese in which blueish tints appear in veins or patches irregularly, though none of them save one is known under blue as a name, and in that one only as part of a name The one exception alluded to is the cheese known as 'Blue-veiny Dorset', which in time gone by had won a good deal of local popularity, but whose fame seems to have faded in recent years This particular cheese, made sporadically here and there over a not extensive district in Dorsetshire, does not possess any feature of its own as a speciality not participated in by other makes. More than any other kind it resembles a Stilton in its blue tints, or a Cotherstone, which is confessedly an imitation of the Stilton alike in outward shape and inward appearance. This last, however, is not so easily attained as that of shape.

The blue discoloration which occurs in many kinds and types of cheese, much to the content of those who enjoy first-class specimens, reveals the growth of the fungus that is known under the name of *Penicillium glaucum*, or pencil fungus, from the manner of its growth. From Stilton cheese it is not separable—or the cheese would not be Stilton; and it is valued not only on account of the appetizing look which it contributes to the cheese when ripe, but also to the piquant flavour which it certainly promotes, or perhaps creates. The spores of this fungus are widely distributed in the atmosphere, from which they find their way into the soft curd of Stilton cheese in process of making.

Some cheesemakers—not in the British Islands, however—systematically propagate the fungus in bread that has been specially prepared, and this in order that the cheeses they make shall have the advantage in flavour and in mellowness which the fungus contributes during the period of ripening. This is done in the case of the well-known Roquefort cheese, which for the most part is made from the milk of sheep. Specially prepared bread, permeated with the fungus, is finely crumbled, and a little of it is scattered upon each layer of curd as the hoop—or vat—is being filled for press. In this way the fungus is communicated to the curd at an early stage, though at a less early one than in the Stilton way of making cheese, yet at the same time systematically and certainly.

In the workroom of a Stilton cheesery of old standing the air is charged with the spores of the fungus, and they find lodgment all about the place. And as the curd, in a soft, spongy condition, lies exposed for hours to the oxidizing influence of the air, the spores of the fungus settle down upon it, and so the seed is sown. It will be noticed that, in the Stilton method, impregnation by spores is less systematic and direct, than by bread as in the case of Roquefort cheese. For all that, however, in an old Stilton workroom the spores exist in such vast numbers that a sufficient deposition of spores on curd is wellnigh a certainty.

The start of a new Stilton dairy anywhere will be expedited and perfected by having numerous bits of ripe, blue-moulded Stilton cheese laid all about the room to throw off spores that will thoroughly impregnate the air. This has been found necessary, too, in England where Camembert cheese was being made; the cheeses would not ripen until the atmosphere of the room had been charged with the spores of the particular fungus—not *Penicillium glaucum*—which go to give the correct flavour and mellowness that together form a *sine qua non* in a Camembert cheese. And so, too, in Derbyshire, Cheshire, Lancashire cheese, and also in Cheddar, the presence of blue mould commonly indicates not only a ripe but a toothsome cheese as well. [J. P. S.]

Blue Grass (*Poa compressa*, L.).—The famous Blue Grass of Kentucky is a kind of meadow grass or Poa, specially suited for growth of poor sandy land. Through the sand the underground stems creep extensively in the horizontal direction, and send up air shoots bearing small leaves blued over with waxy particles. In habit of growth and in agricultural value this species is closely allied to our Smooth-stalked Meadow Grass (*Poa pratensis*). Distinction, however, is easy, for the Blue Grass has its straw quite flat, not round, and the leaf-blade is thickly blued over with waxy 'bloom' exactly as in our swede. [A. N. M'A.]

Blue-grey Cattle, so called from the bluish-grey colour of their coats, are crosses produced by mating Shorthorns with cattle of the Galloway or Aberdeen-Angus breeds. When the latter combination is used the cross is sometimes called 'Black-grey', and we deal in the first instance with cattle bred from Galloways and Shorthorns. Blue-greys are an exceedingly useful class, and great favourites with many feeders. So far as the young cattle are concerned it matters but little which parent is the Galloway and which the Shorthorn, but a Galloway cow or heifer can be kept much more cheaply than a Shorthorn—possibly to the extent of £2 to £3 per annum—and this accounts for the fact that the popular way of producing blue-greys is to mate Galloway heifers with white Shorthorn bulls. Of the calves 99 per cent will be polled or hornless, and 95 per cent of the blue-grey colour.

These cattle are chiefly bred in the northern part of Cumberland, the eastern parts of Northumberland, and the south of Roxburghshire. Carlisle is the principal market for the sale of the breed, and many hundreds are from this centre distributed over all the best feeding districts of England and Scotland, the auctioneers there disposing of enormous numbers each spring and autumn.

The well-bred specimens of the class are easily and quickly fed, and this accounts for the fact that even in the worst times, when cattle of other breeds are almost unsaleable, good blue-greys can always be cashed at fairly remunerative prices. Many of the best are bought at from two to two and a half years old, for feeding for Christmas exhibitions. Mr Brown, manager on the Drumlanrig estates of the Duke of Buccleuch, disposed of ten steers, two and a half years old, in 1904 at £24 each, and of the same number in 1905 and 1906, getting £22 each in the former year and £21 each in the latter. These cattle were bought to be fed for Smithfield and other Christmas shows.

Representatives of the breed have often taken a leading place at the National fat-stock shows, and twice at least a blue-grey has been champion at Smithfield against all-comers. In 1892 Sir John Swinburn showed a steer, bred by Mr J. K. Harrison, which gained the supreme championship. He was by a Shorthorn bull from a Galloway cow, and at three years and five months old weighed 2276 lb., showing an average gain of weight per day from birth of 1·82 lb. The success of the breed was repeated in 1897, when a steer bred the reverse way—that is by a Galloway bull from a Shorthorn cow—came to the front. He was shown by Mr John Worsley, his breeder having been Mr. Parkin Moore, Whitehall, Cumberland. This animal at two years and ten months old weighed 1800 lb., showing a daily gain of weight from birth of 1·75 lb. He had previously been champion at the great shows at Norwich and Birmingham. In the year 1907 the champion at York Christmas Show was a blue-grey, which weighed 2310 lb., and was sold for £72. The best results in breeding are got from mating really good Shorthorns with really good Galloways. It is a fatal mistake to think any kind of bull or cow is good enough to breed crosses. Disappointment and loss follow the use of inferior sorts. Several attempts have been made to establish a breed of blue-greys — that is using blue-grey bulls and blue-grey heifers—but all such attempts have been unsuccessful, the stock bred in this way being much inferior both in colour and symmetry to the first cross of the Galloway and Shorthorn, which, generally speaking, have the good properties of two of our best beef breeds, and frequently grow to a greater size than either of the parents.

Blue-greys of the right sort should have a moderately short, broad, polled head, deep shoulders, wide chest, well-sprung ribs, and broad loins, which should be well and evenly covered with flesh. The hind quarters should be lengthy and well meated down to the hocks. The bones must not be too coarse, and the coat should be fine and silky and well mixed with silvery hair. Indifferently bred cattle can be detected by the long, narrow face — sometimes adorned by scurs or small horns—the ‘herring’ back, and the lanky thighs, while the skin will be sleek, with short wiry hair.

In districts where blue-greys are reared, a considerable number are kept for dairy purposes. They are generally good milkers, and altogether healthy satisfactory cows. The young cattle are extremely hardy and easily reared, thriving and doing well on very moderate keep and in the most exposed places.

In the north-eastern counties of Scotland many Aberdeen-Angus heifers are mated with Shorthorn bulls, and in no part of the kingdom is more attention paid to the breeding of animals for feeding purposes, the greatest care being taken in the selection of the males to be used. The young produced, variously called ‘blue-greys’ and ‘black-greys’, are strong, healthy, and easily fed, but need better keep and more considerate treatment than the Galloway Shorthorn crosses.

Of late years many Galloway and Aberdeen-Angus bulls have been taken to Ireland to mate with the Irish Shorthorn cows, and numbers of young blue-grey cattle have been in turn sent across to Scotland and England to be fed. Generally these prove cattle of a good class. Altogether the blue-grey is one of the most popular and valuable of our feeding animals. In his youth he is easily and economically reared. At a comparatively early age he will fatten readily, and his carcass when dressed shows remarkably little white or surface fat. It thus weighs well and cuts up satisfactorily. The heifers of the breed, although not growing to such sizes and weights as the steers, are even more easily and quickly fed, and make the best of beef. [W. B.]

Blue Gum Tree. See EUCALYPTUS.

Bluehead Caterpillar. See DILOBA.

Blue Milk is a communicable disease of milk which was of not infrequent occurrence in the past. At the present day it is not so often reported. The surface of milk at rest assumes a grey or dark-blue colour in isolated patches. The coloured spot has the appearance of a drop of black-blue ink which has dropped on the surface. The patches may, later, become confluent, and the entire surface take on a blue colour. The colour increases in intensity as acidity increases. The disease may become apparent in milk in from twenty-four to seventy-two hours.

This condition in milk is due to the activity of a micro-organism. Its communicable nature was established in 1838. The causal organism, *Bacillus cyanogenus*, has since been isolated and studied. It belongs to a class of micro-organisms which produce chromogenic changes in milk or other substances. Colour is the natural and apparently the only product of these bacteria. *B. cyanogenus* has the power of very active movement. It does not liquefy gelatine. Sterile, neutral milk inoculated with the bacillus does not become blue, but grey. The blue colour is developed only when the medium has a slightly acid reaction, such as that produced by the introduction of lactic-acid bacteria. There is here a case of symbiosis in milk. *B. cyanogenus* is destroyed by an exposure of a few minutes to moist heat at a temperature of 176° F. It is able to resist drying very successfully, and on this account is somewhat persistent.

This abnormal condition in milk is not of great economic importance. With careful dairy management the conditions are not such as are favourable to its rapid development. [W. St.]

Blue Stone. See COPPER SULPHATE.

Boar.—It may appear to many old breeders of stock to be unnecessary at the present time to call particular attention to the admitted fact that success in the breeding of stock—especially of crossbreds—depends so very largely on the male parent. Many writers have completely proved, to their own satisfaction at least, that the sire more particularly impresses his form and fattening qualities on his produce than does the dam, and probably for this and for other reasons they most strongly advise the use of a pure-bred sire rather than a pure-bred dam when mating one pedigree parent with one of no particular breeding. This advice is most certainly sound when applied to the breeding of crossbred pigs, the benefits derived from the mating of say a pedigree Large White or a pure-bred Middle White boar with a sow of any or of no type or breed are simply marvellous. Of course the results are more marked when the sire used is from a herd which has for many generations been strictly bred for certain qualities, and in this herd the animals must have been somewhat closely bred, as the male is so much more prepotent and more strongly stamps its good and particular qualities on its offspring. To mention one instance of this, 99 per cent of the produce of a pure-bred Large or Middle White boar from a sow of any other breed will be of the same colour as the sire. This may or may not be due, to a certain extent, to the fact that the so-called Yorkshire White pig has been bred pure for a longer period than the pigs of any other breed; but in the writer's opinion there exists a doubt as to this, as within his knowledge the change in the colour of the skin of the Yorkshire pig has been very considerable during the last half century. In the middle of the 19th century a very large proportion of the Yorkshire pigs had much of blue or even black on the skin, although the hairs growing from these coloured spots were of a white colour.

Although the particular object or market for which the pigs may be bred will, of course, have considerable effect on the size, special characteristics, and quality of the boar selected by each owner for use in his herd, yet there are certain points which are as desirable, or undesirable, in the boar of whatever breed, as in the males of any of our breeds of domesticated animals. Take vice, for instance, as exemplified in bad temper. Nothing is more hereditary, and in pig breeding more disastrous in its effects, as a vicious and ill-tempered sire or dam is a continual source of danger to other animals and to all human beings who come in contact with it, especially endowed as is the boar for offence and defence. Not only so, but a restless, nervous, and uneasy animal will spend much of its time in pacing its house instead of contentedly resting and converting into meat the expensive food which has been given to it. Another point of great importance to be studied when selecting a boar for service, is its freedom from hereditary diseases, and its possession of evident robustness of constitution. Even when a stock-breeder in a weak moment determines to use a cross-bred sire, it is very desirable that these two points should be particularly attended to, but it is vastly more important when a pure-bred sire is selected for use, since the latter will be much more prepotent owing to its qualities having become fixed from so many of its forbears having been selected on account of their possessing certain particular qualities.

There may be other characteristics which the boar should possess. These will vary somewhat according to the particular pure breed or to the special type of store or fat pig which the pig-keeper may desire to produce; but there are certain other general points in the make-up or form of the animal which should be secured if possible. These include a comparatively light jowl, head of fair length and wide between the ears, eyes bright and intelligent, neck muscular but not fat, shoulders light and well laid, chest wide, ribs well sprung, back long, flank thick and well let down, loin strong, hind quarters long, with hams well developed, legs comparatively short, ankles strong, and bone fine. The skin should be of fine quality, and the hair plentiful but not coarse. The testes should be comparatively large, and even in size, with the scrotum fitting close to the body. Although a sufficiency of well-formed and evenly placed teats may by novices be considered to be unnecessary in the make-up of a boar, the fact remains that our most successful breeders of profitable pigs make this a point of importance, since the female produce of the boar are almost certain to possess the same characteristic.

[S. S.]

Board of Agriculture. — For twenty-nine years of our agricultural history (1793–1822) the title Board of Agriculture was applied to a body, which was not a Government Department, but rather a chartered Society with many ex-officio, ordinary, and honorary members, and a Government grant of £3000 a year. It was formed on the suggestion of Sir John Sinclair to promote improved methods of husbandry and to encourage a development of agricultural production, in an age when our forefathers were seriously concerned with the sufficiency of the food supply of a population not one-fourth of the present. The old Board, under the Secretaryship of Arthur Young, doubtless succeeded in giving an impulse to the enclosure and cultivation of unproductive land. Its local surveys, moreover, provided a valuable record of the agricultural conditions of Great Britain a hundred years ago. The present Board of Agriculture, or, to give it its full title as expanded by later legislation, 'the Board of Agriculture and Fisheries', is the youngest Department of the State. No doubt another office— the Board of Education—came into its statutory designation at a still more recent date, but the change in that case was one of name only. The Board of Agriculture Act of 1889, on the other hand, not only took over and concentrated a series of duties previously scattered among older offices or casually administered, after a fashion now generally discarded as inconvenient, by separate Commissions, but actually established a new Ministry. The designation of 'Board' as applied to certain Government Departments is sometimes misapprehended; but it has its explanation in the development of our national history, and even the apparent anomalies of organization mark successive changes in the relations of the Executive Government and the Legislature. The Boards are indeed survivals of the older committees of the Privy Council, and they are now manned by high officers of State, with departmental duties of their own, while the President of each Board is alone the Minister responsible to Parliament for the doings of his office. The Board of Agriculture, besides its President, has a nominal roll of members, comprising technically all the Secretaries of State, the Lord President of the Council, the Secretary for Scotland, the First Lord of the Treasury, and the Chancellors of the Exchequer and of the Duchy of Lancaster, but the executive duties are discharged by the usual establishment of a Ministry, with Parliamentary head, Permanent Secretary, Assistant Secretaries, and Staff.

The existing Board fulfils the various functions for which the old Board was created, but it has also a wider purview. The necessity for some distinctive representation of the agricultural interest in the inner counsels of the Government became apparent as the growth of the commercial and industrial elements in the nation absorbed a growing preponderance of legislative attention. It required, however, the invasion of cattle plague in 1865, with its display of administrative confusion, and of actual uncertainty as to where the responsibility lay for the action of the central Government in such an emergency, to force the question into prominence. Even then it took an agitation of wellnigh a quarter of a century before the country was convinced of the need of a new Department It is true the first steps were quickly made by arming the Privy Council with new powers, and by conceding a system of agricultural statistics to Great Britain, such as Ireland had possessed long before But the latter work was left in the hands of the Board of Trade, and it was not until agricultural depression made itself felt in 1879 that the Duke of Richmond's Royal Commission formally recommended a complete Ministry of Agriculture The ear of the legislature being thus awakened, Mr. Gladstone endeavoured to meet the continuous pressure of the Chambers of Agriculture by bringing, in 1883, the statistical work of the Board of Trade into touch with the veterinary work of the Privy Council Office, under a distinctive Committee of the Lords of the Council This makeshift arrangement fell short of what was wanted, and the Government of Lord Salisbury, after an unsuccessful Bill in 1888, succeeded in passing the Act of 1889, under which the Board of Agriculture was established, with Mr Henry Chaplin as its first President. The new Department combined in one office the Privy Council's agricultural duties, with new and enlarged statutory functions for the collection of statistical data and the furtherance of technical instruction in agriculture and forestry. The new Office took over the administrative functions of the several Tithe and Copyhold and Inclosure Commissions, which had been previously concentrated in the Land Commission established under the Settled Land Act of 1882. Another important service—the Ordnance Survey of the United Kingdom—was transferred from the Office of Works, and at a later date the Board acquired from the same Department a centre of botanic investigation and information in the Royal Gardens at Kew. An omission in the original constitution of the Agricultural Department has been partly remedied by the personal relations established at a much later date between the Commissioners of Woods and Forests and the President of the Board in respect of the Crown Lands. A less-expected development, and one which experience has yet to justify, was made by a statute of 1903, whereby the Board of Trade surrendered its control of the inland and sea fisheries of England and Wales. These are now administered in a separate Fisheries Division of the Board of Agriculture.

The three other divisions of the Department, each under an Assistant Secretary of its own, discharge its distinctively agricultural duties. These, in the inverse order of the seniority of the Statutes they administer, are known as the Intelligence Division, the Animals Division, and the Land and Statistical Division. To the first named is allotted the relatively novel educational work of the Board, which inspects and assists collegiate centres acting for groups of counties, or separate schools, in England and Wales. Experimental investigations are also aided by the Board's grants, while as a new duty, without exact precedent in an ordinary Government Department, direct technical information is diffused throughout Great Britain by a monthly journal and by means of reports and leaflets, the gratuitous distribution of the latter exceeding a million in some recent years To this division of the Board falls also a variety of functions concerning the checking the adulteration of agricultural products, and the Acts relating to the Sale of Food and Drugs, Fertilizers and Feeding-stuffs, and so on, while touch is maintained with local agricultural conditions through a staff of honorary agricultural correspondents in every county of Great Britain.

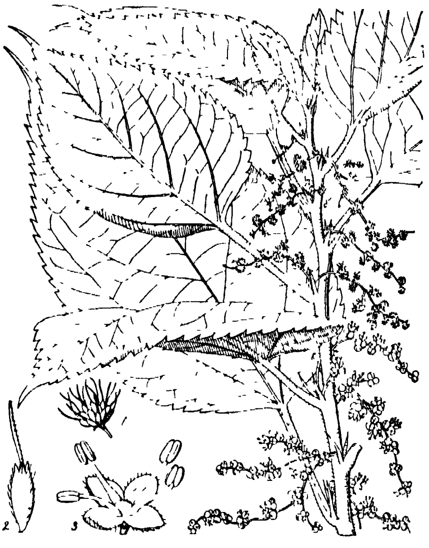
The Animals Division of the Board continues the successful administration of the Acts relating to contagious diseases and the movement of animals, which has given the farmers of Great Britain the freedom now enjoyed from imported diseases of stock, such as cattle plague, pleuro-pneumonia, foot-and-mouth disease, and rabies. A more difficult and tedious struggle is being waged with swine fever and sheep scab. This portion of the Board's duties necessarily involves the employment of a large staff both of executive and of veterinary inspectors of various grades.

A still more varied set of functions, bringing the Department and its officers into relation with individual agriculturists, are concentrated in the Land and Statistical Divisions of the Board Much labour is involved in the continual readjustments of Tithe, in Copyhold transactions, and those arising out of the Inclosure and Regulation of Commons, the supervision and sanctioning of Land Improvement loans, Land Drainage schemes, sales of Glebe Land, as well as the sales, purchases, and loans of Universities and Colleges, while other duties arise in connection with various statutes such as the Settled Land Act and the Agricultural Holdings Acts. The numerous decisions to be given make large demands both on legal knowledge and technical skill, and no less than eighty-four separate Acts of Parliament had to be enumerated in the Schedules to the Act of 1889, from the Tithe Act of 1834 onwards. Later statutes have added to that record, and the sums dealt with run into large figures. Estates in all parts of Great Britain have been indebted to the improvement works, for which moneys have been borrowed, at first from public funds and then from private companies, under the supervision of the Board and its predecessors. Four-fifths of the £18,000,000 already invested in this way represent outlays on drainage, farm-buildings, or labourers' cottages. The statistical side of this Office carries on some of the oldest as well as some of the newest features of Governmental action in this country. In the weekly, quarterly, and annual Corn Returns, a system of price records going back to the 18th century maintains a link with the past. The more modern statistics of cattle disease and movements of animals at home and abroad are essential to the work of the Board. The Annual Agricultural Returns of crops and live stock have proved indispensable to agriculturists in the difficult times of recent years. Representing a work initiated in 1866, they have been largely improved and extended in later years with the willing co-operation of half a million occupiers of land, and the active assistance of a considerable army of officials. Still more lately, through estimators of produce and market reporters at leading centres, the Board supplies estimates of yield and current prices, and places this information in the hands of the public with a completeness and promptitude not yet attained by any of the Agricultural Departments of countries which have enjoyed much longer than our own the services and advantages of a Ministry of Agriculture. [P. G. C.]

Bob-tailed Sheep Dog, a breed of dogs more widely recognized as the Old English Sheep Dog. See OLD ENGLISH SHEEP DOG.

Bobying, a term which came into use with the introduction of Boby's Patent Corn Screen, to denote the operation of cleaning corn by that machine.

Boehmeria nivea, the botanical name of the plant commercially known as ramie, a kind of Indian nettle, and the source of a fibre which for strength, fineness, and lustre is pre-eminent among vegetable fibres, and inferior only to silk. It is exceedingly easy of cultivation, thriving in any kind of soil in climates so far apart as those of the British Islands and the Tropics. It has a root system similar to that of the common nettle, the fleshy underground stems being perennial and creeping, with a crowded arrangement of buds which develop annually and form stems from 6 to 8 ft. high, as thick as a man's thumb, and bearing large heart-shaped green leaves with toothed margins and clothed beneath with a white, silky tomentum. The fibre is contained in the bark of the stems. These are cut as soon as they turn brown at the base, so that the crop is easily harvested. As many as twenty stems per square yard are produced by established plants under ordinary conditions; it will therefore be seen that so far as a supply of the raw material is concerned, ramie can be grown in this country with a yield equal to that of any plant cultivated agriculturally. Every bit of the underground stem will root and grow quickly into a strong plant. Pieces ½ in. long, placed in heat in spring and afterwards planted outside in June, produce on the average six good stems each by the following October. The plant may also be readily increased by means of seeds, which are freely borne by cultivated plants, and can be bought in quantity from dealers. The seeds should be sown in a frame in light soil like those of lettuce, and when the seedlings are large enough to be handled they should be pricked out in boxes of light soil in the same way as young celery. From these they can be transplanted to the open field in June. The growing stems will not bear frost, the treatment, therefore, must be similar to that afforded to plants that are too tender to grow in the open air, when there is any danger of frost. Once established in the ground, there is no fear of frost doing the rootstocks any material harm. The yield of fibre is at the rate of 5 oz. of dry fibre from twenty stems 6 ft. long, and it is calculated that at this rate about half a ton of dry fibre per acre could easily be produced in this country. So far as the cultivation of the plant is concerned, and the production of raw fibre at comparatively little cost, ramie presents no difficulty. In tropical countries the yield is greater, of course, than in any part of the United Kingdom, still, ramie would pay as an agricultural crop here if a satisfactory process of dressing the fibre could be discovered. On this really hangs the whole problem of the ramie industry, and its solution has baffled the cleverest experimenters for the last fifty years. The Government of India forty years ago offered a reward of £5000 for a satisfactory method of preparing ramie fibre for textile purposes, but although many competitors tried, none succeeded in obtaining the reward. The French Government has also offered from time to time prizes for machines that would dress ramie stems satisfactorily, and although several machines which have come near to the desired object have been placed upon the market, the machine still remains to be invented that will make ramie a pronounced commercial success. No system of preparation which cannot produce clean unbleached fibre under £30 per ton is likely to succeed in establishing this article firmly in the estimation of European textile manufacturers. [W. W.]



Ramie (*Boehmeria nivea*)

1, Female flower (cluster) 2, Single female flower
3, Male flower

Bog Asphodel (*Narthecium ossifragum*)— This is a rigid herbaceous perennial bog plant belonging to the Rush order (Juncaceæ). It is common on wet moors and the boggy sides of mountains where sheep are pastured. In such localities the plant is easily recognized by the sharp-pointed rigid leaves springing from the wiry underground stem, and by the bare stalk emerging from the leaves, with a spiked cluster of pretty yellow flowers at its end. It used to be thought that if a sheep ventured to eat of the Bog Asphodel it would suffer from liver rot. [A. N. M'A.]

Bog Bean or **Buck Bean** (*Menyanthes trifoliata*).—The beautiful Bog Bean is a perennial marsh and bog plant of the Gentian order (Gentianaceæ). It has a creeping stem which bears leaves each composed of three leaflets, like a clover. The flowers are very beautiful, and are arranged in pink-and-white racemes on special scapes. The leaves of the plant contain a bitter tonic, and country people often make Bog-bean tea, which they bottle up for medicinal use. [A. N. M'A.]

Bog Earth, a dark-grey compost of sharp, sandy soil and the decomposed roots of heath, largely used by gardeners for growing heaths. It is found on dry, heathy commons, but may be artificially prepared. In the cultivation of orchids, ferns, &c., a dark-brown variety of bog earth, consisting of decayed roots of bracken, leaves, and other vegetable matter, with little sand, is used.

Boglands, Planting of.—Whatever be the cause of their formation, whether simply low-lying, swampy, water-logged tracts, or peat bogs generally extending from accumulations of decayed moss growing over an impervious subsoil of stiff clay or hard moorpan, boglands are always laden with stagnant water containing humic and other acids in far too large a proportion to enable woodland crops to thrive properly. Even the hardiest and least exacting of our indigenous trees, Scots Pine, Birch, Aspen, Alder, and Willow, cannot be expected to form profitable crops on such cold, water-logged soil in its unreclaimed state.

Before planting can have the remotest chance of succeeding and being profitable, the impervious subsoil must either be broken through sufficiently at its lowest parts, or else drainage (which see) must be undertaken by cutting open drains to remove the injurious excess of soil-moisture and to allow the soil to subside and become partially aerated; for even after drainage it generally remains cold, dull, and inert for some time, until the organic matter partially decomposes. And while it is almost always necessary to clear to a greater or less extent the rough soil-covering of heath, heather, coarse grasses, and other bog plants, a certain amount of soil-preparation is usually necessary in the way of throwing up banks or mounds before the reclaimed land is suitable for planting with any fair, reasonable chance of profit. The extent to which such drainage, clearance, and soil-preparation are either in the first place necessary, or else in the second place desirable for purposes of profitable planting (and the planting of such tracts is usually merely a question of profit), should be carefully considered before any scheme of reclamation is begun. The special nature of the bog has to be considered; for moorland bogs vary greatly in this respect, and however thick may be the accumulations of dead vegetable matter, the trees to be planted must be able soon to reach the mineral soil in order to have any fair chance to thrive. The nature of the bogland, and the practicability and the cost of drainage and soil-preparation are therefore the main points which need consideration, for the mere work of planting can usually be done cheaply by means of notching, either by the ordinary slit method or with the planting stick. The choice of trees that can be grown is usually limited to the hardiest kinds of softwoods and conifers, Birch, Aspen, Alder, and Scots Pine under ordinary conditions, although on the better classes of boggy and peaty land Black Poplars (common and Canadian), White Willow, Weymouth Pine, Spruce, and Silver Fir sometimes do well. Any large choice is seldom given, but where they are likely to succeed the rapid-growing Black Poplars are the most profitable, then White Willow and Weymouth Pine—the latter, however, only in sheltered situations. Where the local conditions limit the choice to Birch, Scots Pine, Alder, and Aspen, it is often doubtful if the timber crops are likely to grow well enough to be a good investment, and the question of profit is then mainly dependent on (as it is always in all other cases greatly affected by) the proximity or distance of local markets for pine as pit-wood and softwoods for pulp-making, matches, &c. Closer planting than 4 by 4 ft. (2722 per acre) will seldom prove profitable, unless there is a fair demand for small early thinnings, though Black Poplars or White Willow need not be set closer than 6 by 6 ft. (1210 per acre). [J. N.]

Bog Myrtle or **Sweet Gale** (*Myrica Gale*, nat. ord. Myricaceæ). On bogs and moorlands one often comes across a conspicuous shrubby plant 2 to 3 ft. high, whose leaves when bruised emit a very strong and pleasing fragrance. This shrub is the Bog Myrtle, the badge of the Campbells. The leaves of the plant are dotted all over with resin glands, and it is from this resin that the fragrance is exhaled. [A. N. M'A.]

Bog Products. See PEAT.

Bog Rush (*Schœnus nigricans*).—This plant belongs to the Sedge family (Cyperaceæ). It is a common perennial tufted herb on bogs and wet moors. The leaves are stiff bristles, with shining dark-brown sheaths. The stems are quite wiry, and 10 to 12 in. high. The spikelets are collected into a head. [A. N. M'A.]

Bog Spavin is an enlarged condition of the hock, due to distension of the capsule of the true hock joint, with an excess of synovial fluid. It is characterized by a tense, fluctuating swelling, chiefly in front of the joint, occasionally extending around the sides, and in bad cases often conjoined with thoroughpin. It is due to a chronic synovitis, or inflammation of the synovial membrane lining the capsule of the hock joint, and seldom or never causes lameness. It is seen most commonly in cart horses, particularly those of the Clydesdale breed, and especially in those whose hocks stand out rather far behind. It may be brought on by any severe, prolonged exertion. It is extremely unsightly, and for this reason often calls for treatment.

We must be guided by the general appearance of the case as to the best line of treatment to adopt. In slight cases of recent origin, extended periods of cold-water irrigation, combined with subsequent applications of some cooling and astringent lotion, such as the familiar white lotion composed of Goulard's extract 1 oz., sulphate of zinc 6 dr., and water 1 pt., may be sufficient, or the first half of a linen bandage may be soaked in the lotion and applied after the cold water, with the idea of exercising a beneficial pressure.

In cases of longer standing, mild counter irritation by painting with some preparation of iodine may be tried; in those that are obstinate in yielding to the above treatment, the contents may be drawn off by an aspirator, and the cavity injected with a weak solution of iodine; but the very greatest care and attention to strict antisepsis must be observed, as there is nothing easier when puncturing a synovial cavity than to infect it, when the last state may very easily become a great deal worse than the first. After withdrawing the contents in this manner it is necessary to apply pressure in some form or other to prevent it from refilling. This may be done by the application of a spring truss, very carefully regulated, or better still by a 'charge' applied around the whole joint. As a last resource, and if the blemish is not objected to, one may line fire and blister, but great care must be taken in firing the front of a joint, and on no account must a line come immediately in the bend. [H. L.]

Bogs.—Peat bogs, or 'mosses' as they are sometimes called, are vegetable deposits, forming an important feature of the temperate and arctic regions of northern Europe and America. In Europe they occupy extensive tracts in the British Isles, North-German plains, Denmark, Sweden, Holland, and some of the river valleys of northern France; and they cover large areas of the northern United States, Canada, and Newfoundland. In Great Britain the bogs are chiefly confined to the mountain districts, although some important ones are found at a low level, such as Solway Moss on the western border of England and Scotland, which is 7 miles in circumference, and Chat Moss in Lancashire, which has an area of 10 sq. miles. The principal mountain bogs are found in the western and north-western Highlands of Scotland, and in the Hebrides. The bogs of Ireland are much more extensive than those of either Scotland or England, and cover about one-seventh of the entire surface of the country. The Bog of Allen, the largest in the British Isles, has an area of 240 sq. miles, and extends, with some interruptions, right across the great Central Plain almost from Dublin to the Shannon.

There are two kinds of bogs common in the British Isles: the high-level, also called mountain or 'black' bogs, and the low-level or 'red' bogs. They are unlike in many respects, although both kinds have had a similar origin. The low-level bogs have usually on their surface a wet semi-fluid stratum, 5 or 6 ft. in thickness, representing the half-decayed light-brown vegetable matter of recent growth, and resting on the more compact peat beneath. Their surface, from continual additions of new peat, is normally above the level of the surrounding land. This sometimes, unhappily, leads to disaster, when from excessive springs and rainfall a bog bursts, and the mud-flows submerge the agricultural lands of the neighbourhood. The depth of peat in a red bog is usually considerable, ranging from 20 to as much as 50 ft. Black bogs, on the contrary, are rarely more than from 6 to 12 ft. deep, but have a firmer surface, due to better drainage, and to the denudation of the top layers.

Peat is entirely destitute of lime, and is poor in the other mineral constituents which most plants require for their normal growth. Owing to its spongy nature it retains a very high proportion of water. These peculiarities restrict the vegetation on the surface of an unreclaimed bog to plants of no agricultural value. Praeger (Topographical Botany of Ireland, pp. xxx, xxxi) gives the flora of a typical red bog near Frankford, King's County, as follows:—*Calluna vulgaris* (Ling), *Scirpus cæspitosus* (Deer's Hair Sedge), *Erica Tetralix* (Bell Heather), *Eriophorum vaginatum* (Bog Cotton), *Eriophorum angustifolium* (another Bog Cotton), *Narthecium ossifragum* (Bog Asphodel), *Drosera rotundifolia* (Sundew), and *Rhynchospora alba* (a sedge). Owing to different conditions of drainage, elevation, and aspect, the flora of black bogs is not so constant in its character as that of the bogs of the plains. The undrained high-level boglands are dominated chiefly by *Eriophorum angustifolium*, in association with *Calluna vulgaris*, *Eriophorum vaginatum*, &c.; those lower down the mountain side are in possession of *Scirpus cæspitosus* and its associates; while on the lower well-drained mountain slopes Calluna is the dominant plant (see Pethybridge and Praeger, Proceedings of the Royal Irish Academy, vol. xxv, Sect. B, No. 6, pp. 158–169).

The existing peat bogs are comparatively recent additions to the earth's crust. They are of postglacial age, but evidence of the occurrence of interglacial peat exists, as at Lauenburg, on the Elbe (Wahnschaffe, Die Ursachen der Oberflächengestaltung, &c., pp. 225, 6), and at Hailes Quarry, near Edinburgh (Prof. James Geikie, The Great Ice Age, 3rd ed., pp. 99, 100).

The great bulk of the peat of northern latitudes is formed almost entirely from the decay of the different species of Sphagnum. These are spongy mosses capable of holding a large quantity of water; they grow in dense tufts, and spread themselves rapidly over the ground. In addition, they possess the remarkable property of being able to send off luxuriant shoots from their upper extremities whilst the lower parts of the plants are in process of decay. A high rainfall and a low temperature are the climatic conditions which most favour their growth.

The bogs of the plains have developed chiefly in the water-filled hollows of the boulder clay, left on the recession of the great ice sheet which covered the country during the Glacial Epoch In very many cases lakes at first occupied these hollows, and freshwater molluscs, such as Limnæa, have left at the bottom a pure calcareous deposit, white and friable, often styled 'shell marl'.

The formation of peat frequently began with the decay of reeds, sedges, and similar swamp plants, which grew on the bottom of these water basins, and, when the accumulation of vegetable matter reached the surface level of the water, the development of the bog was continued by the growth and subsequent decay of the Sphagnum mosses and other peat-forming plants. At times (see Merrill, Rocks, Rock-weathering, and Soils, 1906, pp 302 7) the Sphagnum spreads in floating masses from the margins of the pool, and is weighed down from time to time to the bottom by the growth of heavier vegetation on the tangled mass The high-level bogs have been produced by similar agencies in mountain valleys, and in hollows on the mountain tops Those frequently found on steep mountain slopes have probably originated in small hollows on the mountain side, and have then spread, as from so many centres, over the whole surrounding surface.

The *Hochmoore* of the North-German Plains are of a character similar to the high- and low-level bogs of this country. The *Flachmoore* or *Grunlandsmoore* of the Germans, on the other hand, are more akin to the fens of England; they have been formed under water, and from plants requiring a certain amount of lime for their growth.

A section of a peat bog exhibits a well-defined stratification in which a regular plant succession can be traced, affording a valuable clue to the climatic changes which have passed over northern Europe since the Glacial Epoch. Weber distinguished five different strata in the Hochmoore of north-west Germany. From this succession he concluded that, since the Great Ice Age, two warm and dry, and two cold and damp periods have existed, one of the latter extending to the present day. Fischer-Benzon, after very careful research on the Schleswig-Holstein bogs, describes several successive strata within one bog. He names the periods in which these strata have been added according to the occurrence, vertically, of the predominating forest trees in the different peat layers. He found that the Birch predominated in the forests of the lowest strata, and was succeeded in turn, towards the surface, by forests of Pine, Oak, and Beech respectively. A similar succession has been observed in Denmark, Norway, and Sweden.

From an agricultural point of view, both black and red bogs are of vast importance, as they nearly all admit of reclamation, the basis of which is thorough drainage, liming, and the addition of clayey material or even sand (see next art.). In their unreclaimed condition they furnish the farmer with a cheap fuel, and provide him with a valuable absorbent bedding for his farm animals. See BOGS, RECLAMATION OF. [T. H.]

Bogs, Reclamation of.—The British Isles include a very considerable area of bog-land, much of which is favourably situated for reclamation, though the level of agricultural prices during the past thirty years has been too low to justify the application of capital for the purpose of bringing further land under cultivation. In the first half of the 19th century, on the other hand, particularly in periods of high prices, large sums were laid out in enterprises of this kind. The absence of any prospect of a satisfactory return has led to the subject being dropped in this country, but on the Continent the question of utilizing these unproductive stretches of country has received much attention. Societies for the purpose of encouraging the development of peat lands exist in Germany, Austria, Denmark, Holland, and Sweden, while there are a number of State experimental stations and moor farms devoted to the same object On the whole the result shows that there are many ways in which bog-land may be successfully utilized, and particularly that with the aid of artificial manures it is possible to reclaim it at much less cost than was formerly the case

DRAINAGE.—Generally speaking, the first step is to change the unfavourable physical condition of the soil so as to enable cultivated plants to exist This can only be effected by drainage, which admits air, and allows the decomposition of the peat

The method adopted in many of the older reclamations in England and Ireland was to construct open parallel drains at a distance of say 70 yds. apart, 4 ft. wide at the top, 4 ft. deep, and 14 in. wide at the bottom. At right angles to these and discharging into them, smaller covered drains were laid at an average distance of 16 ft These drains would be about 18 in wide at the top and 6 in at the bottom. They had a total depth of 3 ft., being 22 in. to the shoulders or ledges (which were 3 in. wide) and 14 in from the shoulders to the bottom. The drains were covered with a top spit, which was placed grass side downwards on the shoulders, and the peat which had been dug out was thrown over them. The distances at which the drains were placed and the slope of the sides would, of course, vary according to circumstances

Another method which has been adopted on very wet bogs in Ireland is that of wedge draining, which is employed in order to prevent the cuttings from filling in. The plan is to dig open pits along the line of the drain 18 ft long, 12 ft. deep, and 12 ft. wide, gradually sloping to about 3 ft. wide at the bottom. Unbroken spaces of 3 or 4 ft. were left between the pits, and as the latter were completed the intervening spaces were tunnelled through, thus providing a passage for the water, while the bridge or unbroken space above acted as a wedge and prevented the drain being filled up by lateral pressure.

Apart from open drains, pipes can be used, but they are apt to prove unsatisfactory, as they are very liable to be shifted from their original position by the subsidence of the bog. Generally their employment can only be recommended where they can be laid on or in the subsoil. A plan which has been found satisfactory on the Continent consists in making open drains first and then putting in pipes when the land has settled. The drains are made about 2 ft wide and rather over 2½ ft deep, about 65 ft apart; the following year they are deepened to 4 ft and the pipes laid and covered. If the bottom is still soft they may be supported by laths to keep them in position.

Bush drainage may also be practised, the trenches being filled in with some open material, such as thorns, faggots, and brushwood, and the soil pressed down upon it. An improvement on this, which has been successful in Austria, consists in placing two or three boards at the bottom of the trench, with supports between, so as to allow of through drainage. This can only be adopted in places where rough boards and waste wood from sawmills can be obtained cheaply. Another system, which would be suitable where the undergrowth of woods is available, or where the bog or peat has some wood growing on it, is described in the Zeitschrift fur Moorkultur, 1906. In the first place a ditch is dug about 2½ ft wide at the top, 1 ft wide at the bottom, and about 4½ ft deep, the material being placed on both sides. A strong rail or pole is laid at the bottom, and two stout faggots about 2½ ft long placed crosswise over it, their ends resting against the side of the ditch. The pole beneath prevents them from sinking into the ground. On these crosspieces, which leave a fairly wide opening, three or four stout poles of alder or fir are laid, which support the weight of the covering of earth and prevent the drain from falling in. The space between the poles may be filled in with branches, loppings, &c., and a wooden pipe hollowed out of a stout pole may be also inserted as an additional security. This system of drainage is recommended by Dr Bersch, the Director of the Admont Moor Experiment Station in Austria, and is, in his opinion, to be preferred to any other wherever the necessary material is easily available. Stoppage of the drain is not likely to occur, and the work is so simple that, given a sufficient fall,—3 per 1000 at least—it can be carried out by intelligent workmen without technical help, and is eventually cheaper than open drains. Cross drains may be made in the same way.

Drainage by this or any similar method is generally more satisfactory than by open drains, as the latter involve a material loss of surface and always make cultivation more difficult. With open drains, moreover, the land is affected by frost, not only from above, but also from the sides of the drains, so that drainage does not begin until the ground has thoroughly thawed. Covered drains, on the other hand, continue to work in winter, especially when the ground is covered with snow. The pole drainage mentioned above has been known to act during a continuous hard frost, when the ground was a yard deep in snow. The advantage of this is that the ground dries quicker and can be cultivated earlier in the spring.

The degree of drainage to be given to bogland is of great importance, and care should be taken that it is not overdrained. It is easier to remedy underdraining than overdraining. The main point is the local rainfall and its distribution during the year (see DRAINAGE).

CULTIVATION AFTER DRAINAGE.—The first step, which may be done at the same time as the draining, is to grub and clear the surface of stones, bushes, &c. Then, if the turf is not too matted and uneven, it should be ploughed. Any strongly made plough will answer, but the iron must be kept sharp. If the ground is soft the horses may be shod with wide 'pattens', to which they soon become accustomed. If, however, the surface is too rough and broken, or full of roots and stones, for a plough, the first cultivation must be done by the spade. A good workman can dig from 4 to 5 sq. perches 9 in deep in a day. It is very useful to fire the surface in dry weather so as to burn off the rough growth. The next step is to break up the soil to a suitable tilth by working it well with a cultivator or disk-harrow, and then thoroughly to level the surface.

Where marl or calcareous gravel or sand could be obtained in the neighbourhood, the usual method of reclamation has been to spread this on the surface after the preliminary cultivation. This was the system pursued in all the large reclamations made in the first half of the last century, and it has been practised very largely on the Continent, particularly in Germany, where a subsoil of sand frequently occurs. It is, however, a system which can only be successfully carried out where the marl or sand can be obtained easily and where the cost of labour is not prohibitive. The amount of sand required to provide a layer of 2 or 3 in over an acre is very large, and makes it a serious undertaking. On this account the method of direct cultivation, without any dressing, is recommended as being much less expensive.

Another means of preparing the ground for cultivation is by burning. The land should be ploughed lightly, strips about 4 ft. wide being left at intervals. The furrow slices are then cut across in lengths about 3 ft. each, and when sufficiently dry, slowly burned in heaps on the intervening spaces. These should be pared from day to day, and the parings placed on the heap to keep the fire from breaking out. Modern authorities, however, regard this method as wasteful and unsatisfactory.

MANURING.—Peatland may in general be regarded as land poor in fertilizing constituents combined with unfavourable conditions. It is by no means universally true that peat is chemically poor. Dr. Bersch of the Admont Experiment Station (Zeitschrift fur Moorkultur, vol. iv, part 3, 1906) gives the following particulars showing the variation in eight samples of peat from different districts, compared with the four typical soils:—

Character of Soil.	Per Cent.			
	Nitrogen	Potash	Phosphoric Acid	Lime
Light loamy sand	0·048	0·035	0·026	0·039
,, loam	0·151	0·440	0·125	0·550
Heavy loam	0·325	0·665	0·178	3·028
Calcareous sandy loam	0·172	0·333	0·180	10·048
Samples of soil from low moorland (Flachmoor)				
From Laibacher Moor	2·15	0·14	0·22	3·63
,, Galicia	3·31	0·10	0·30	9·86
,, Galicia	1·96	0·08	0·17	0·86
,, Northern Tyrol	2·89	0·15	0·37	5·23
Samples of soil from upland moor (Hochmoor)				
From Leopold's Moor, near Salzburg	1·46	0·12	0·08	0·50
,, Ibm Moor, near Salzburg	0·63	0·13	0·02	0·57
,, Freundsheim, Tyrol (a mixed moor)	1·18	0·26	0·08	1·04
,, Gutenbrunn, in Lower Austria	1·52	0·20	0·20	0·56

The percentage composition of the dry matter in peat soils does not, however, afford a satisfactory indication of the available plant food owing to variations in density, and for purposes of comparison the quantity of chemical constituents present in 1 acre of soil 8 inches deep is also given

Character of Soil	Quantity contained in 1 acre of Surface 8 in deep, in pounds			
	Nitrogen	Potash	Phosphoric Acid	Lime
Light loamy sand	1,267	924	708	1,029
,, loam	3,986	11,616	3,300	14,520
Heavy loam	8,580	17,556	4,699	86,592
Calcareous sandy loam	4,540	8,791	4,752	276,672
Samples of soil from low moorland (Flachmoor)				
From Laibacher Moor	9,770	636	1,000	16,496
,, Galicia	13,014	392	1,179	38,767
,, Galicia	9,161	386	2,268	4,150
,, Northern Tyrol	13,258	688	1,697	23,994
Samples of soil from upland moor (Hochmoor)				
From Leopold's Moor, near Salzburg	2,296	188	126	785
,, Ibm Moor, near Salzburg	1,469	303	47	1,329
,, Freundsheim, Tyrol (a mixed moor)	4,126	909	280	3,637
,, Gutenbrunn, in Lower Austria	2,230	293	293	1,262

It will be seen that lowland bog possesses a far greater store of chemical constituents than hill peat. It is deficient in potash, but rich in nitrogen, while the supply of phosphoric acid is somewhat low A fair amount of lime is frequently present, and the practice of liming, which was formerly common both in England and abroad, has been partially abandoned as the result of numerous experiments at the German Stations for Moor Cultivation, and has been replaced, especially in the first year's cultivation, by heavy manuring with basic slag or raw phosphates.

In view of the variation in the chemical constituents of different kinds of bogland no definite figures as to the amount of manure can be given, but Dr Beirsch furnishes the following general statement as an indication of the amounts which have been found useful. It will be seen that the manuring in the first year is very heavy.

	Lowland Bog		Upland Bog		
	1st Year	2nd Year	1st Year	2nd Year	3rd Year
	Pounds per acre				
Phosphoric acid	90-135	55-90	180-270	90-180	45-55
Potash	110-180	70-110	180-270	90-180	90-180
Nitrogen	—	-	45-68	27-45	27-45

EQUIVALENT QUANTITIES OF THE ABOVE INGREDIENTS IN COMMON MANURES. Cwts. per acre.

Basic slag (17 per cent phosphoric acid)	4·7–7	2·9–4·7	9·4–14·1	4·7–9·4	2·4–2·9
Kainit (12½ per cent potash)	7·9–12·9	5–7·9	12·9–19·3	6·4–12·9	6·4–12·9
Nitrate of soda (15 per cent nitrogen)	—	-	2·6–3·9	1·6–2·6	1·6-2·6

Generally it may be said that where nitrogen is required, farmyard manure is probably the best fertilizer. It has also the advantage that it is rich in bacteria, in which bogland is usually very poor, and for this reason the inoculation of bogland with nitrogen may also be tried. Basic slag may be applied either in autumn or spring, and also superphosphate to lowland bog where easily available phosphoric acid is required, but superphosphate has not always been found suitable for hill peat, raw phosphates being generally better. With regard to potash, either kainit or 40-per-cent potash salts may be used. Manure should generally be applied in the spring, but kainit and basic slag may be put on in the autumn.

FIRST CROPS. The first crop which the newly reclaimed bog is to carry deserves careful consideration, as it materially affects the decomposition of the soil and the growth of weeds, moss, &c. The choice, however, is naturally limited by local circumstances and by the character of soil. If the turf is well decomposed, potatoes, roots, or even barley or oats, may be suitable, but potatoes should generally be preferred. These give a very satisfactory yield the first year; they assist in breaking up the peat, and they have the advantage of being planted somewhat late.

The following description of the method practised on the Bavarian moors gives a good idea of the system adopted in cases where bogland is reclaimed simply by cultivation and manuring. Potatoes are invariably selected as the first crop, manure being applied at the rate of 180 to 270 lb. phosphoric acid, 180 to 270 lb. potash, and 68 to 90 lb. nitrogen. The superphosphate and potash is spread broadcast before planting, the nitrate of soda being applied about three weeks after planting. Potatoes are again planted the second year, and receive about 110 lb. phosphoric acid, 110 lb. potash, and about 40 lb. nitrogen. They may yield as much as 10 to 15 tons per acre, but after the second year the yield diminishes, so that in the third year winter rye is chosen. The same amount of potash and nitrogen is applied as in the second year, but only 55 lb. phosphoric acid. In the fourth year oats are grown, or fodder crops such as peas and vetches. Many garden vegetables also give good returns if heavily manured. The land may be laid down to grass and clover, which does very well for two or three years. After that it tends in some cases to deteriorate, and has to be ploughed up and the land again cropped. The success of bogland for permanent pasture is very variable. In some cases suitable manuring with basic slag and kainit will so improve the natural flora that cultivation is unnecessary. Generally, however, it requires cultivation before laying down the grass, and annual manuring in order to maintain a heavy yield. The results of a large number of experiments conducted in Germany show that a much heavier yield of hay is obtained by breaking up the ground and resowing with a good grass mixture, than by merely harrowing and manuring. As frost is apt to be injurious, it is a useful measure to roll the grass after cutting before the frost comes, and again in the spring in order to consolidate the soil.

An example of the suitability of potatoes as a crop on bogland is given in the Irish Farmers' Gazette, where some very damp bog was roughly drained and dressed at the rate of 15 tons of farmyard manure per Irish acre, together with 8 cwt. of a mixture composed of 1 part sulphate of ammonia, 1 part muriate of potash, and 4 parts superphosphate. The crop was sprayed three times, and a yield of between 7 and 8 tons per statute acre was obtained.

In addition to potatoes, carrots, grain, roots, fodder crops, and vegetables, there are a few other crops which have been occasionally cultivated, such as maize, vines, and hops. A note in regard to the last crop may be of interest, as its cultivation on peatland has been contemplated in England. According to an article in Zeitschrift für Moorkultur (vol. iv, No. 1, 1906), hops have been cultivated since 1900 with considerable success in Austria near Salzburg, where some 125 ac. are now planted. Basic slag is applied at the rate of about 10 cwt. per acre, with 3 cwt. of 40-per-cent potash salts, and 5 tons of farmyard manure. In the spring a handful of nitrate of soda is given to each plant. New plantations receive double these amounts for the first year. The question of the most suitable manure is, however, a matter for experiment. The plantations made in 1901 yielded 8 cwt. per acre in 1903, 13 cwt. in 1904, and 13½ cwt. in 1905, while those planted in 1903, which were not so thickly set, yielded about 6½ cwt. in 1904 and 1905. The quality was satisfactory, and it is stated that the yields compare favourably with those obtained elsewhere in Austria.

CONCLUSION.—On the whole it may be said that bogland in almost all cases admits of satisfactory reclamation, but on account of the very great variation in physical conditions, situation, chemical composition, &c., methods which may be suitable in one case are not necessarily suitable in another. Judging from the experience obtained abroad, it seems not improbable that there are large areas which would admit of satisfactory improvement at a reasonable outlay; but one difficulty which is likely to arise in this country is the absence of any scientific advice based on practical experience, such as is obtainable in most of the countries in Europe, where the question of utilizing the various types of bog has been systematically studied for many years past.

Very little indication can be given of the cost involved, but where drainage is on a simple scale it should not be very heavy. The Prussian Forest Administration have reclaimed some 15,000 acres at an outlay of £90,000. Where the surface has been covered with sand or marl the average cost has been £10, 16*s* per acre, but where this has not been done the cost has only been £4, 9*s*. per acre. The average return on the outlay during the three years 1904–6 is stated to have been at the rate of 9 per cent in the first case, and nearly 20 per cent in the second The utilization of peat for fuel and for other industrial purposes is dealt with under the heading of PEAT [R J T]

Boiled Food. See FOODS, PREPARATION OF

Boiled Milk. See MILK

Boilers.– The apparatus used for generating steam consists of three main parts the furnace, the boiler, and the chimney The furnace is the part in which the heat is generated, by the combustion, usually, of coal or coke upon a fire-grate. The boiler is the closed vessel in which water is converted into steam by the application of heat. The chimney is the part through which the products of combustion pass from the boiler to the atmosphere.

HEATING SURFACE —The heat is supplied to the boiler partly by radiation from the hot fuel in the furnace and partly by the furnace gases, which impinge on portions of the surface of the boiler as they pass from the furnace to the chimney, the portions of the boiler surface which are thus acted upon on one side by radiant heat or the hot furnace gases and have water on the other side, constitute what is termed the 'heating surface' of the boiler. The so-called 'power' of a boiler, or the rate at which it will produce steam, depends chiefly upon (1) the area of the fire-grate, and (2) the area of the heating surface

The first determines the amount of fuel the boiler will consume, and the second determines the amount of heat which the boiler can absorb. If the heating surface be too small, there will be a loss of fuel economy consequent upon the unnecessarily high temperature with which the products of combustion pass to the chimney, on the other hand, if it be too large, the draught —which depends chiefly upon the difference of temperature of the furnace gases in the chimney and the outside air—will be insufficient for the proper combustion of the fuel In practice, various devices are resorted to in order to obtain the requisite amount of heating surface; outside flues, internal fire-tubes, and water-tubes being used for this purpose

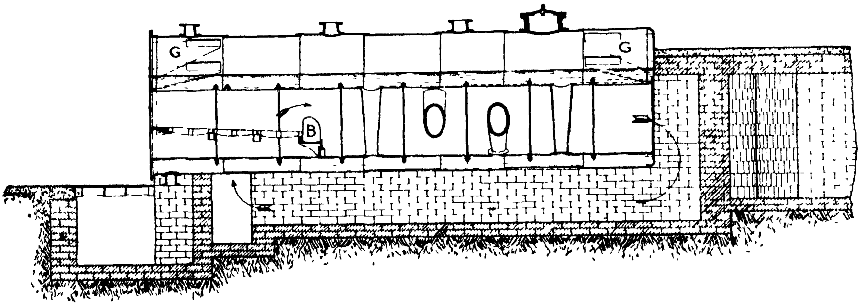


Fig 1 —Cornish Boiler longitudinal section B, Firebrick Bridge G, G Galloway Tubes

FORM AND MATERIALS —In the early days of boiler construction, the boilers, which were externally fired, were often made of copper; and as the steam pressures used were but slightly greater than that of the atmosphere, but little regard was paid to the form of vessel best suited to withstand internal fluid pressures Modern boilers, however (with the exception of water-tube boilers, which are always externally fired), are almost always internally fired; and as the steam pressures now used are very considerable —often exceeding 200 lb per sq. in —due regard must be paid not only to the suitability of their form to bear such pressures, but to the materials of which they are constructed as well The strongest form of vessel for withstanding fluid pressures is the sphere, but this form is never used for boilers on account of the cost, the difficulties of construction and setting, and for many other practical reasons. Next to the sphere the cylindrical form is the strongest, and as this is also the most economical and simplest to construct, it is universally adopted for modern boilers There are many varieties of boilers, however, arising chiefly from such practical considerations as—adaptability for a particular purpose, cost of construction and of upkeep, fuel economy, rapidity of getting up steam, &c ; but all of these may be roughly divided into Shell Boilers and Water-tube Boilers.

SHELL BOILERS – A shell boiler is a large closed vessel containing water and a steam space or reservoir; it also usually contains one or more furnace tubes or internal flues, when it is called a flue boiler: and, in addition, it may contain a number of small tubes, called fire-tubes, through which the furnace gases pass to the chimney, when it is called a multitubular or fire-tube boiler. A water-tube boiler, on the other hand, is externally fired, and consists, chiefly, of a large number of comparatively small tubes, in which the steam is generated, and through which the water circulates. The two forms of stationary shell boilers principally used are the Cornish boiler and the Lancashire boiler.

The Cornish boiler (figs. 1 and 2) was adopted by Trevithick, the Cornish engineer, in 1801, and is still used, particularly for heating purposes, and for small installations where considerations of first cost are of primary importance. It consists of a horizontal cylindrical shell with flat ends and a single internal furnace tube, of about half the diameter of the shell, extending from the front to the back end of the boiler.

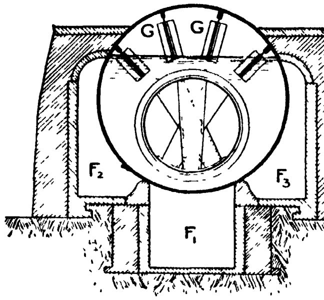


Fig 2 Cornish Boiler end section

F_1 F_2, F_3, Flues   G, G, Galloway Tubes

The Lancashire boiler (fig. 3) was introduced by Fairbairn and Hetherington in 1844. It is similar in form to the Cornish type, but larger, and has two internal furnace tubes instead of only one. The brickwork setting is also similar to that of a Cornish boiler, so that the following description will apply to both.

The shell is built up of belts or hoops of steel plate, 3 ft. to 4 ft. in width; the hoops overlapping at the edges, as shown in fig. 1, and the joints made secure by riveting. The furnace tubes are also built up in sections, and these, which consist of short tubes flanged outwards at the edges, are connected by riveting the flanges of adjacent tubes together, with a caulking ring interposed between them. To increase the heating surface of the boiler and—what is more important—promote the circulation of the water within it, Galloway tubes are sometimes used These are conical tubes running transversely across the furnace tubes at intervals along their length, as shown in figs. 1 and 2. Each furnace tube, for a distance of from 6 ft. to 7 ft. from the front end, is divided into two parts by a sloping fire-grate—the furnace being above the grate and the ash-pan below which terminates in the firebrick bridge B. Enclosed between the boiler and its brickwork setting (except at the back) are three flues, one at the bottom and two at the sides, which are lined with fireclay covers The boiler rests upon firebrick blocks, as shown in fig. 2, which support the shell well above the bottom of the side flues, so as to prevent outside corrosion taking place should any water find its way inside these flues.

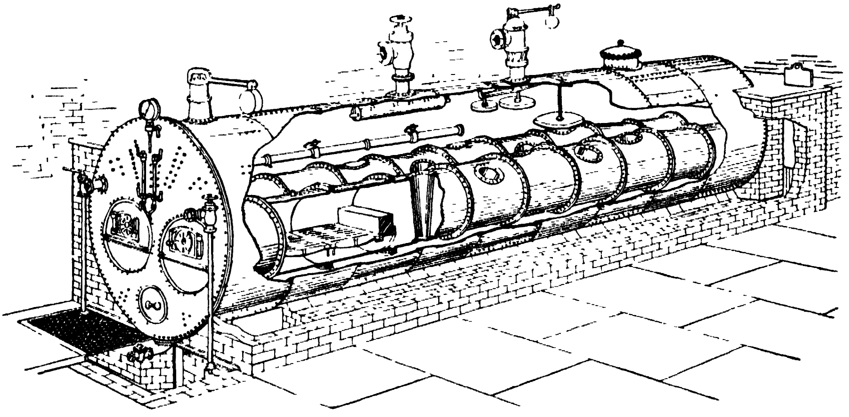


Fig 3 —Lancashire Boiler

The products of combustion pass along from the furnace, over the bridge B (fig. 1), to the end of the furnace tube; they then return by the bottom flue to the front end of the boiler, and then back along the side flues to some little distance beyond the back end of the boiler, where the two streams unite and pass along to the chimney.

Cornish boilers are made in various sizes, but the most usual size is about 5 ft. 6 in. in diameter and 20 ft. in length, and a boiler of this size will generate about 2000 lb. of steam per hour, or sufficient for an engine of about 100 indicated horse power. Lancashire boilers, however, are commonly 7 ft. 6 in. in diameter and 30 ft in length, and capable of generating 6000 lb of steam per hour, or sufficient for an engine of 300 horse power.

The Lancashire boiler is less smoky and more economical of fuel than the Cornish type, and these advantages are due to the former having two separate furnaces, which permit of alternate firing; so that the mixture of smoke and unburnt gases from the newly fired furnace is to a large extent consumed in the flues on mingling with the much hotter gases from the other furnace. A modification of the Lancashire boiler is shown in fig. 4, which represents a Galloway boiler. The two furnace tubes of this boiler unite, beyond the bridge, into one having a flat section, which thus allows of a greater number of Galloway tubes being used, with a consequent increase in the heating surface.

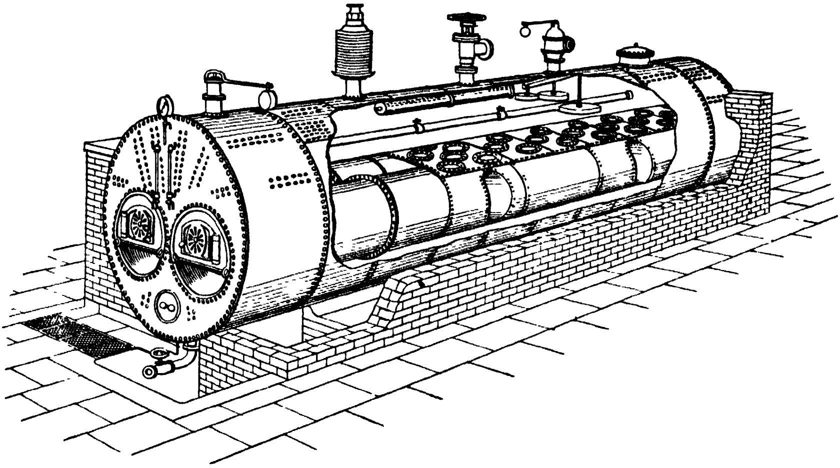


Fig. 4.—Galloway Boiler

Vertical Boilers.—In large boilers the axis of the cylindrical shell is usually horizontal, but in small boilers, where fuel economy is not a matter of supreme importance, it is more often vertical. Unlike the Cornish and Lancashire types, vertical boilers do not require a brickwork setting; and they have the further advantage of occupying comparatively little floor-space. The comparatively small surface of water from which the steam is generated, however, is a disadvantage, as it increases the risk of priming, that is to say, of the boiler passing water along with the steam. There are various forms of vertical boilers, all of which, however, have an external cylindrical shell with an internal fire-box, of which the grate forms the floor. The type of vertical boiler selected for illustration is the 'Cochran' boiler, of which a section is shown in fig. 5. In this figure it will be seen that the fire-box communicates, through a short neck on the left, with the combustion chamber, which is lined with firebrick. The furnace gases first pass into the combustion chamber, where, aided by the high temperature of the firebrick lining, the combustion is rendered more or less complete; they then pass through a number of tubes to the smoke-box on the right, and then up the funnel. The tubes, of course, are completely surrounded by water, the surface of which should not be less than about 3 in. above the crown of the combustion chamber.

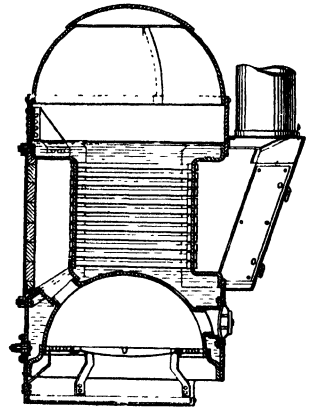
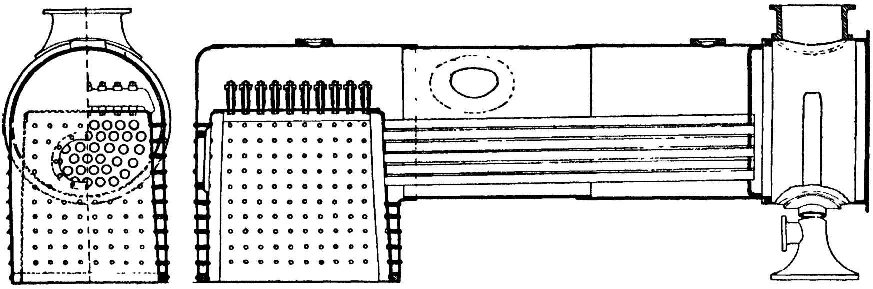


Fig. 5.—Cochran Boiler

Locomotive Boilers.—A locomotive boiler of the stationary type is shown in fig. 6. The fire-box, which is of copper and almost rectangular in form, is connected to a horizontal, cylindrical steel shell, called the barrel, which contains a large number of fire-tubes, and which terminates at the front end in the smoke-box. The fire-box is enclosed by an outer shell of steel, forming an extended part of the barrel, and to this the flat sides of the fire-box are tied by copper stay-bolts screwed into the plates and riveted over. The crown of the fire-box is stiffened by having a number of girder stays bolted to it on the top. The tubes through which the furnace gases pass to the smoke-box are usually of brass, $2\frac{3}{4}$ in. in internal diameter, and are important, as they form a large part of the total heating surface of the boiler. To reduce as far as possible loss of heat by radiation, the barrel of the boiler is usually covered with silicate cotton, or felt, over which a layer of wood is placed, and then an outer covering of sheet iron.

Marine Boiler.—The ordinary marine or 'Scotch' type of boiler consists of a horizontal cylindrical shell of steel with flat ends, containing, within, from two to four corrugated furnace tubes, internal combustion chambers, and a number of return fire-tubes. A small boiler of this type is shown in fig. 7. The furnace gases pass over the fire bridge into the combustion chamber, and then return through the tubes above the furnaces to the uptake. The sides and back of the combustion chamber are tied to the cylindrical shell and the back plate of the boiler respectively by screwed stays, and the crown is stiffened by means of bridge stays. About one-fourth of the return tubes are screwed into the front and back tube plates and provided with thin nuts on the outside to serve as stays. The upper parts of the flat ends of the boiler are tied together by a number of direct stays, which extend from the front to the back of the boiler, with nuts and washers at the ends. The return tubes, like the tubes of the locomotive boiler, are of importance, as they form by far the greater part of the total heating surface of the boiler. By the use of tubes in this way, the necessary amount of heating surface can always be obtained without resorting to external flues. For this reason multitubular boilers do not require brickwork settings, and consequently take up less floorspace than ordinary flue boilers of the same capacity.


End Section

Longitudinal Section

Fig 6 Locomotive Boiler, stationary type

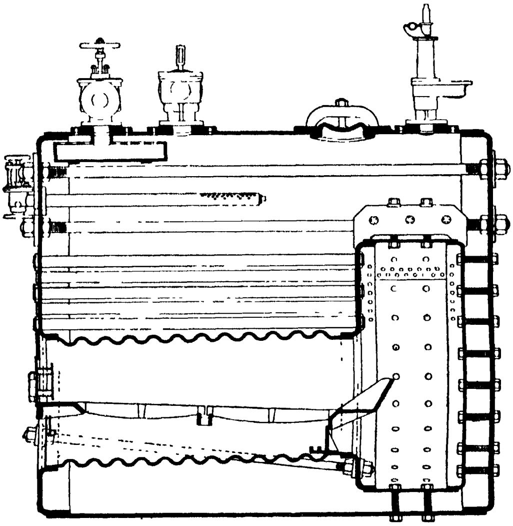


Fig 7 —Marine Boiler

Water-tube Boilers.—An example of this type of boiler is illustrated in fig 8, which represents the well-known 'Babcock and Wilcox' boiler. The inclined tubes are joined at the ends to 'headers' or connecting boxes, which are also connected by tubes to a horizontal drum overhead. The tubes are enclosed within a brickwork setting, and the space between the tubes is divided into three sections by 'baffles', in such a way that the furnace gases pass upwards between the tubes in the first section, then downwards in the second section, and then upwards again between the tubes in the third section, and away to the chimney. Water enters each of the inclined tubes at the back end of the boiler and flows along in a continuous stream to the front end; becoming partly converted into steam as it flows. The mixture of water and steam then rises into the steam drum, where the steam separates from the water and collects in the steam space forming the upper half of the drum.

Water-tube boilers, as compared with shell boilers capable of producing steam at the same rate, have the following advantages: (1) They are lighter; (2) they contain far less water and steam; (3) the time required to get up steam is less; and (4) consisting as they do of a number of comparatively small elements, they can be readily transported to and erected in confined situations, such as basements of buildings. [H. B.]

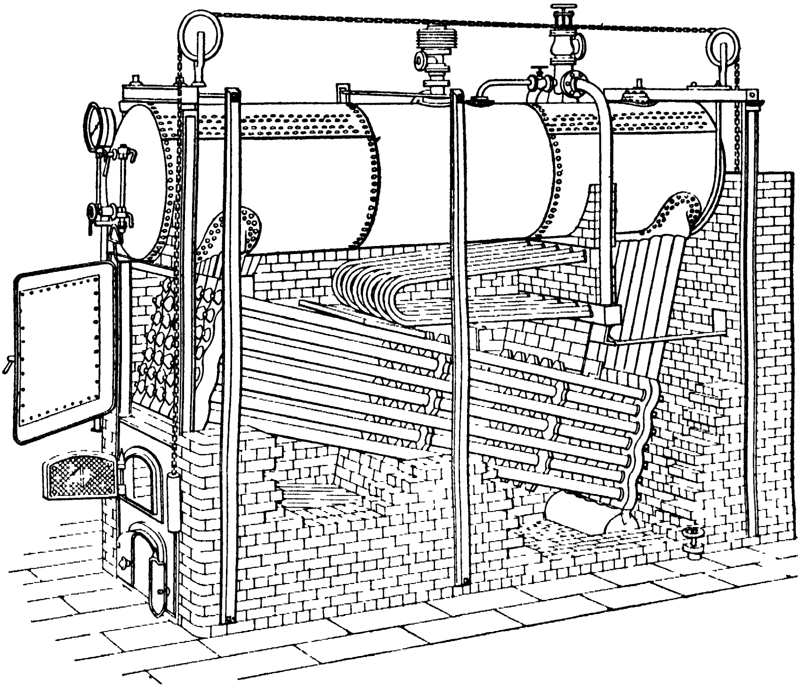


Fig 8 —Babcock and Wilcox Boiler, fitted with Superheater (integral with Boiler), for stationary purposes

Bokhara Clover, a leguminous plant belonging to the genus Melilotus. See MELILOT.

Boll.—This is an old measure which, although still in more or less general use, is not a legal one. It is seldom heard of south of the Humber, but from there to the north of Scotland it is still in general use, not only for grain but for other articles. Its capacity varies from district to district, and in scarcely two counties does it represent the same volume, while in Lanarkshire there are two different measures known as bolls. Not only does the capacity of the boll vary from district to district, but it changes according to the substance which is being measured. As a rule, with grains which are still within their husks, such as oats, barley, or bere, the boll is from 50 to 100 per cent greater than where the grains are naked, such as in wheat, beans, or peas. This, however, is not always the case, as in Ayrshire the boll of wheat, beans, and peas, which are naked, is 4 bus., while with oats and barley, which have an outside husk, it is 8 bus., but of perennial rye grass seed, which has also an outside husk, the boll is only 4 bus.

For wheat in the north-eastern counties of England the boll is 2 bus., while on the opposite side at Carlisle it is 3 bus., and at Berwick it is 6 bus. Over nearly the whole of Scotland the boll of wheat is 4 bus., and the same applies to the Isle of Man. In most districts the same number of bushels which constitute a boll in wheat also apply to beans and peas, and in some cases also to rye.

In the north of England the boll of oats or barley is generally 6 bus., but at Hexham it is only 5 bus., while at Alnwick on the east it is 6, and at Wigton on the west it is 12 bus. Throughout Ayrshire the boll of oats is 8 bus., but generally throughout the remainder of Scotland it is 6 bus. Oatmeal and also barley meal used to be sold by the boll, but in this case, while the old word 'boll' has been retained, the amount does not vary so much as in the case of the grains, and instead of being measured, as they are, it is weighed. In the majority of cases the boll of oatmeal or barley meal is about what would be produced from a boll of oats or barley grown in that district. Thus in Ayrshire a long oat called Tam Findlay is most generally grown, the acknowledged standard weight per bushel for which is 35 lb., and in many districts, particularly in late seasons, this weight is not reached. A boll of 8 bus. of such oats will usually give about 140 lb. of meal, or 50 per cent of the weight of the oats. In other districts over the midland counties of Scotland, where different varieties of oats are grown, the weight per bushel is about 44 lb., and 6 bus. of such oats produce about the same weight of meal as are obtained from 8 bus. of 35 lb. in Ayrshire. Over a great part of Scotland, therefore, the boll of oatmeal may be considered as 140 lb. This weight seems to have been the original standard of the measure, and the boll of oats, barley, or bere appears to have been varied in proportion to the quantity of these which was necessary to produce 140 lb. of meal.

Potatoes are still occasionally bought and sold by the boll, which, as in the case of grain, varies with the district. In the Lothians the boll of potatoes is 4 cwt., but in some districts it is 5 cwt., while in the Wigton district of Cumberland it is 8 cwt.

Lime is still occasionally sold by the boll, which like the other articles varies according to its condition and the district in which the transaction takes place. For lime shells the measure most generally allowed to the boll is 4 bus., but where slaked lime is referred to, double this quantity, or 8 bus., is commonly allowed. This variation in the measurement of a boll of lime and lime shells seems to be based on the same idea as that of the boll of oats and oatmeal, viz. that the boll contained an equivalent of each. [J. S.]

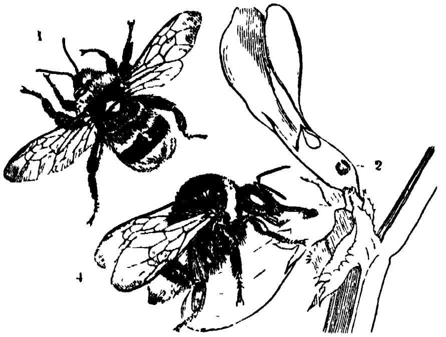
Bolting Food.—The animal that swallows his food unmasticated, or in such haste as to pass it down without proper insalivation, is said to bolt it. It is a very objectionable habit, and may arise from a variety of causes, as greediness, dental imperfections, injuries to the tongue, or in very old horses to loss of power in the masticatory muscles. Cattle suffering from wooden tongue (see ACTINOMYCOSIS) are tempted to swallow their food as quickly as possible during the early stage of the malady, while later on their inability to roll the morsel induces what is known as 'quidding' or dropping of partly masticated meals. The cause should be sought and removed. When bolting is simply due to a greedy disposition, the animal should be made to consume a considerable amount of dry chaff with his corn, as swallowing is rendered more difficult, and the glutton must needs devote longer time to insalivation before it is possible to swallow. Bolting of food results in colic and various forms of indigestion, and should be regarded as a matter of serious consequence.

[H. L.]

Bombay Cake, a variety of undecorticated cotton cake. See COTTON CAKES.

Bombus, the genus of *Hymenoptera aculeata* (Apidæ), to which the true humble bees or 'bumble' bees belong. They are of social habits, the female living through the winter and making a rude nest in or on the ground. The long tongue possessed by these bees renders them especially useful in cross-fertilizing deep-cupped flowers, such as those of the clover tribe, to the nectaries of which shorter tongued insects are unable to obtain access. There are about fifteen British species, difficult to distinguish except by the sexual organs of the male. The commonest species are *B. terrestris*, *hortorum*, *agrorum*, *lapidarius*, *sylvarum*, and *pratorum*.

[C. W.]



1, Wood-Bee (*Bombus lucorum*). 2, 3, Holes cut by bees in bases of flowers. 4, Humble Bee (*Bombus terrestris*) extracting nectar through one of the holes.

Bombyces, a group of robust moths with blunt-ended, furry bodies, and short, usually pectinated antennæ. Some of the genera were formerly grouped together in the family Bombycidæ, now obsolete. The type is the Silkworm Moth, *Bombyx mori*. Many moths of economic importance belong to this group. The Lackey Moth, formerly known as *Bombyx neustria*, is now called *Clisiocampa neustria* (which see).

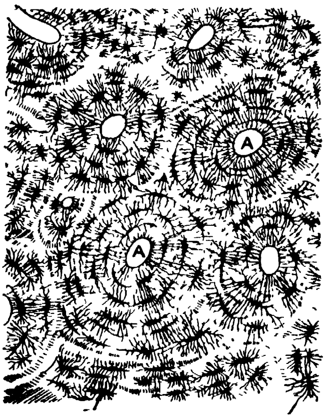
[C. W.]

Bondon Cheese.—To a class very different from Backstein, in the all-important element of quality, Bondon cheese belongs. It is more than a 'full-milk' cheese at its best, for in leading dairies cream is added to curd obtained from milk as the cow gives it. It is made in the usual way of soft cheese, so far as coagulation and draining are concerned, care being taken to prevent hardness of curd that would be inimical to a perfect soft cheese. Its popularity on the Continent is the reward of quality in the article. Not all of it, however, is of the superior quality indicated above. There are makers who, not unnaturally, begrudge the supplementary cream, and seek a remunerative trade for their full-milk cheese pure and simple, just as many makers of Stilton cheese have long been in the habit of doing.

Bondon cheese is a dainty little article of food when nicely made and ripened. It is one of the most welcome of Continental soft cheeses to Anglo-Saxon palates, falling not far behind the Camembert or the Brie, if indeed falling behind at all. Made in different shapes—flat and circular, square, cylindrical—but always small, it is essentially a titbit for a 'snack' in lieu of a 'meal', one little cheese just furnishing enough appetizing food for the occasion.

[J. P. S.]

Bone.—Bone constitutes one of the connective tissues, and is characterized by the structure and physical properties of its ground substance. This consists of an organic matrix, in which are deposited lime salts (calcium phosphate, carbonate, and fluoride), which gives rigidity to the whole structure, thus enabling it to act as the supporting framework or skeleton of the body. The lime salts are uniformly distributed throughout the organic matrix, and in molecular form unrecognizable under the microscope. Owing to the intimate relationship between the lime salt and the organic matrix, either may be removed, while the one left will still show the typical microscopic structure of bone. If a thin section of dried bone be taken and rubbed down between grinding stones until sufficiently thin for microscopic examination, the appearance shown in the diagram is obtained. The bone matrix is now seen to possess a characteristic arrangement and to contain a number of regularly arranged spaces These appear black by transmitted light, because by the method of preparation the spaces have been filled up with debris. According to the amount of matrix present we distinguish *compact* or *spongy* bone. In compact bone, the matrix is arranged in rounded masses, termed *Haversian systems.* In the centre of each system is a cavity, the Haversian canal, surrounded by matrix in the form of a series of concentric layers. The layers are called *lamellæ,* and enclosed between neighbouring lamellæ are a number of small spaces, the *lacunæ.* In fresh bone each lacuna is filled by one cell, the bone corpuscle. Radiating away from the lacunæ are a number of very fine channels, the *canaliculi,* which in the living bone are filled with fine processes of the bone corpuscles. The canaliculi place the lacunæ of successive lamellæ in communication with one another, but it is undetermined whether the processes of the corpuscles lying within the canaliculi come into contact with one another. The neighbouring Haversian systems are united by further lamellæ, which form the whole into a compact mass of bone—these are termed the *interstitial lamellæ.* There are also a number of lamellæ which run parallel to the inner and outer surfaces of the bone. In spongy bone the same main structure is again seen, but the lamellæ are arranged in a more irregular manner, and the spaces enclosed are large in size and of very irregular shape. The examination of a thin section of bone which has been decalcified and fixed shows the bone corpuscles *in situ* within the lacunæ. The structures within the Haversian canals are now seen to comprise an artery and vein, lymphatics, nerves, and a supporting framework of delicate connective tissue. In the large central cavity of the shaft of a bone and in the spaces of spongy bone is contained a quantity of tissue containing much fat, the *bone marrow* The outer surface of bone is covered by a membrane of fibrous connective tissue, the *periosteum.* The outer layer of this is largely fibrous, and is rich in bloodvessels. The inner layer is richly cellular



Transverse Section of Bone

A, A, Haversian Canals The small irregular black spots are the Lacunæ, the lines radiating from them are the Canaliculi.

Bone marrow is of two varieties, yellow and red respectively. In the adult, the yellow marrow is found occupying the shafts of the long bones, while the smaller spaces of the spongy bones are filled with red marrow. Yellow marrow consists mostly of fat tissue. Red marrow, while containing many fat cells, contains also a very distinctive cellular tissue, and is very vascular. Many of the capillaries in this have imperfect endothelial walls. The following varieties of cells are found in the tissue: (1) Lymphocytes and leucocytes similar to those found in the blood. (2) Myelocytes, which are cells rather larger than leucocytes, and containing a round or oval nucleus and a protoplasm with many neutrophil granules. (3) *Giant cells.* These are large cells, spherical in shape, and containing several nuclei. (4) Numerous fairly large cells with oval nuclei, and numbers of coarse acidophil granules in their protoplasm. (5) A number of nucleated cells whose protoplasm contains hæmoglobin. These by losing their nucleus become red blood corpuscles

DEVELOPMENT OF BONE.—In the growing animal, bone is preceded either by a piece of cartilage of the general shape of the bone to be formed, or by a fibrous connective tissue membrane. We may therefore distinguish the formation of bone as *chondral* or as *membranous.* The former, which is the commoner, is the more complex. In this type, the formation of bone takes place both upon the surface of the cartilage and also within its interior. In the case, for instance, of a long bone, the first deposition of bone matrix is seen upon the surface of the cartilage in the middle of the shaft Here a calcified matrix is deposited by certain cells in the inner layer of the perichondrium, the osteoblasts. At the same time the immediately subjacent cartilage matrix becomes calcified, the cell spaces of the cartilage become enlarged, the cells atrophy and are finally destroyed. After a thin layer of matrix has been deposited, some of the cells remain attached to its surface, and become included within the bone matrix by the deposition of a fresh lamella from outside. The thickening of the layer of perichondral bone occurs by an irregular deposition upon the surface, forming a number of trabeculæ. Within the cavities thus left is a quantity of embryonic marrow and bone-forming tissue, and by the deposition of more bone matrix upon the walls of these spaces the cavity becomes gradually smaller until it contains but little more than the bloodvessel. In this manner the Haversian systems are formed.

Endochondral bone formation occurs by the eruption of bone-forming tissue into the centre of the cartilage. The first step in this process consists in the gradual erosion of the cartilage matrix, so that the cartilage soon consists of a trabecular framework enclosing a number of irregular spaces. Into these spaces the bone-forming tissue grows from the surrounding perichondrium. Having gained the interior of these spaces, this tissue then proceeds to deposit bone matrix upon the walls, so that at this stage the trabeculæ consist of an inner part of cartilage covered by a layer of bone matrix of irregular thickness. The growth of the bone takes place by absorption of the pre-existing trabeculæ and bone tissue, and formation of new bone in its place. [T. G. B.]

Bone, Diseases of.—Unfortunately, in animals—especially the horse—the diseases and injuries to bone are frequent,—in fact, the horse is more troubled in this respect than the human subject. Many such diseases in this animal are, and have been from time immemorial, ascribed to hereditary influences, but this is, unquestionably, greatly overestimated as a predisposing cause. Very few men with any experience in horse-breeding will willingly use a sire or dam that they know has ringbone, spavin, splint, or sidebone (see arts. on these diseases), and it is to guard against the perpetuation of these evils that soundness is insisted upon at the various exhibitions. As a precautionary expedient this is advisable, but it is doubtful if there is any real proof that such defects are ever transmitted from sire or dam. Most of the foregoing diseases are excited by external violence, applied either 'direct' or in an 'indirect' manner, though doubtless some are of a constitutional nature, *e.g.* rheumatic in their origin. This is the case in a disease affecting foals, lambs, and calves, known as joint ill or rheumatic arthritis, though the seat of infection is believed to be the 'navel', the antiseptic treatment of which should begin at the time of birth, in order to guard against this disastrous complaint. Veterinary surgeons use the term 'arthritis' when a joint is implicated in the diseased activity. Thus, for instance, there is 'traumatic arthritis', when a joint has been stabbed, and the cartilages of the joint become the seat of disease. Arthritis may assume either 'acute' (fast) or 'chronic' (slow) forms, or there may be a conversion from one state to the other, depending upon circumstances (see ARTHRITIS, JOINT ILL). Dislocations are not uncommon in horses and cattle, less so in sheep, pigs, goats, and dogs. The principal joint dislocation in horses is at the stifle or knee-cap. It slips out of its normal position, owing to a relaxed condition of the ligaments of the joint, and from other causes. Colts are the most frequent sufferers, and if the source of irritation is allowed to continue, the joint becomes a trifle dropsical. Good feeding, blistering, and the maintenance of the part in its normal situation is all that is requisite; in older animals, rest and blistering (see DISLOCATIONS). Fractures are of course the commonest forms of injury to bone amongst all domestic animals, but more so in horses, dogs, and cattle, less frequently in sheep, pigs, poultry, and cats (see FRACTURES). Rickets is a disease of bone common in young stock, especially the dog and the pig, and is apparently due to an insufficiency of lime salts in the food. See RICKETS.

INFLAMMATION OF BONE.—A very common disease of bones is that known as ostitis, or inflammation of the bones. The usual causes are violence and concussion. The disease may be either 'circumscribed' or diffused, and it may be either acute or chronic (see OSTITIS). In chronic inflammation of bone, the process often ends by the part 'sloughing'. See NECROSIS.

SPLINT.—This is a common disease amongst all classes of horses, especially those of lighter draught. It has more significance in horses of the latter class, say under four or five years. During the time that a splint is forming, lameness is very often present, and sometimes afterwards. See SPLINT.

RINGBONE.—Both light and heavy horses are very subject to ringbone, but it is most frequently encountered in cart horses and vanners. It is a chronic inflammation of the bones at or around the pastern joint, very commonly in the fore limbs, though by no means confined to this situation. Sometimes it assumes the form of a complete ring, hence the term 'ringbone'. The integrity of the joint may be completely destroyed. It renders a horse unsound, being incurable, though not always accompanied by lameness. See RINGBONE.

BONE SPAVIN. See separate art. BONE SPAVIN.

ANCHYLOSIS OF BONE.—From external violence, and also from other causes, bones adjacent to one another often become united, and if this occurs about a joint, the proper use of the latter is interfered with. Not only may the bones participate, but also the ligaments of the joint, constituting the so-called stiff joint. When a horse breaks its knee severely, so that the deeper structures are implicated, it sometimes ends in a stiff knee joint, which diminishes the value of the animal by about 75 per cent.

Stiff back is of a similar nature, and not uncommonly prevents the animal from regaining the power to rise after lying down, so that some horses constantly need the aid of the slings to rest in whilst in their stall. See ANCHYLOSIS. [F. T. B.]

Bone Black.—Bone black, which is also known as animal charcoal, bone charcoal, and bone char, is prepared by subjecting bones to destructive distillation. The bones, from which the grease is first removed, are heated in closed iron retorts in a furnace. The heat breaks up the bones, and volatile products are distilled off. These are passed through condensers, where ammoniacal liquor and bone tar are collected. Much of the nitrogen of the bone is contained in the ammoniacal liquor, from which it is obtained as ammonium salts. The tarry liquor also yields a variety of useful products. In addition to these there is a large volume of uncondensable gas, which is burned. The main product is the char, which remains behind in the retorts. Sometimes the bones are partly degelatinized before being distilled, and a portion of the nitrogenous matter is then obtained as glue. Such bones when distilled yield a smaller amount of tar and ammoniacal liquor, but the yield of char is not much affected.

When removed from the retorts the char is cooled and ground to the meals or powders, of various degrees of fineness, in which it is sent out into commerce. It is a black substance, which contains about 10 per cent of carbon or charcoal, the remainder consists of bone ash. The amount of real charcoal present is therefore small. This can be seen by burning a sample of bone char in the air, when the carbon readily burns off, leaving a white ash, which forms nearly 90 per cent of the dry weight of the original. Commercial bone black varies considerably in the percentage of carbon which it contains, but good samples should contain about 10 or 11 per cent. They should contain very little iron, and under 1 per cent of silica. The principal constituent is phosphate of lime, of which 70 to 75 per cent is present. There is also present a little phosphate of magnesia, and from 8 to 10 per cent of carbonate of lime.

Bone char is used chiefly as a decolorizing agent. It was discovered early in the 19th century that it is much more effective as an absorbent of organic colouring matters than wood charcoal. Its main use is in decolorizing syrups in sugar-refining. If the crude syrup, which is brown in colour, be passed through a bed of fresh bone charcoal, the colouring matter is absorbed and the syrup is rendered practically colourless. After the charcoal is used for a time in this way it becomes saturated with the colouring matter and can absorb no more. It is then washed free from syrup, and revivified by heating it again in a closed retort. In this way the bone char can be renewed again and again. But it gradually becomes less porous and effective, until eventually it becomes useless for sugar-refining. It then forms 'spent' char, and is sold to the manure manufacturer. During its use by the sugar-refiner the percentage of carbon gradually increases, as well as the percentages of impurities. The extra carbon is derived from the colouring matters of the sugar, which are charred during the revivifying. Spent char contains about 20 per cent of carbon, a little nitrogen, and phosphate equal to about 70 per cent of phosphate of lime. Its chief value to the manure manufacturer lies in the phosphate of lime. The manure manufacturer uses the spent char chiefly for the manufacture of superphosphate. In the char itself the phosphate is present in the insoluble form of tribasic phosphate of lime or tricalcium phosphate. This is turned into the soluble or monocalcium phosphate by treatment with sulphuric acid (see SUPERPHOSPHATE). The resulting superphosphate is black in colour, but if properly manufactured is an excellent high-grade article.

[J. H.]

Bone Dust. See BONE MANURES.

Bone Manures.—No manures are more popular and highly esteemed among farmers in this country than those prepared from bones. This estimation is on the whole well deserved, but is sometimes carried to greater lengths than the merits of bones justify. Bones are valuable and eminently safe manures, but there is sometimes a tendency to underestimate the value of other manures in comparison with them. The esteem in which bones are held is no doubt in great measure due to the following causes: first, that they have been longer in use than any of the other concentrated manures, and so their use has become an established part of agricultural tradition, second, that they are slow-acting manures, which act gradually and have an effect which is spread out over a considerable period of years, and third, that they are manures which farmers feel confident can always be used with safety and advantage.

Bones have been in use as manure for a very long time. They were used for renovating exhausted pastures in England in the latter part of the 18th century. During the early part of the 19th century their use spread to all parts of Great Britain. In the early days of their use they were merely roughly crushed. Since then the tendency has constantly been to get them into a finer state of division, or to improve their activity as manure by some treatment, such as by fermenting them or by dissolving them with acid.

IMPORTATION AND HOME PRODUCTION OF BONES. Great quantities of bones are used in the British Isles. They are both imported from abroad and collected at home. We import bones from a great many different parts of the world, but the chief sources of supply are the East Indies and the Argentine. Considerable quantities are also imported from Egypt, Morocco, Brazil, and the Continent of Europe. The Board of Trade returns do not distinguish between unground bones, bone meal, steamed bone flour, and bone ash, and it is therefore impossible to obtain accurate returns of the bones imported in different forms. The total import of bones in all forms—burnt, degelatinized, and raw—during three years was as follows:—

1905	1906	1907
47,346 tons	42,607 tons.	45,115 tons

The greater part of this was in the form of raw bones, either ground to meal or unground; but considerable quantities of steamed or degelatinized bones are imported from the Continent of Europe, and particularly from Holland and Belgium. The importation of bones has fallen off somewhat in recent years. A few years ago the annual import exceeded 60,000 tons per annum. This falling off appears to be due partly to the increased consumption of manures abroad, and partly to the fact that the extravagantly high estimate which is placed upon the value of bones in comparison with other manures is to some extent giving way with the spread of agricultural education and manuring experiments.

No statistics are available as to the quantity of bones collected at home for use as manure, and it is very difficult to obtain reliable figures as to this. Calculations made by well-informed persons connected with the trade place the amount at about 60,000 tons per annum. It is said that of the home production about two-thirds are ground into raw bone meal after being degreased. The remaining one-third are degelatinized or burnt, and eventually come into use as manure in the forms of degelatinized bones, bone black, and bone ash. It is probable, therefore, that the total consumption of bones in this country as manure in all forms—raw, degelatinized, and burnt—amounts to about 100,000 tons per annum

Composition of Bone—In the raw or green state bones contain a considerable amount of fat, especially in the marrow This fat, which may amount to about 12 per cent of the raw bone, has no manurial value, but weight for weight is much more valuable than bone itself It is therefore removed by some degreasing process before the bone is made into manure, and is used in the candle, glycerine, and soap industries. The raw bones are also apt to contain meaty matter, hair, horny matter, and siliceous and other impurities. In well-cleaned samples all these are nearly completely removed

A clean, dry sample of bone consists of two parts—a combustible part and an incombustible part, which is called bone ash If we treat a piece of bone with hydrochloric acid we can dissolve away most of the incombustible or mineral matter, and leave behind a tough, flexible, cartilaginous material which is largely composed of a highly nitrogenous substance called ossein The mineral matter which is dissolved away by the acid consists mainly of phosphate of lime, though other lime compounds are also present It is the presence of the lime and other mineral compounds which gives the bone its hardness, while the ossein, which is very similar to, if not identical with, collagen, the substance of which the connective tissues of animals are formed, renders it tough and somewhat flexible About one-third of the weight of clean, dry bone consists of this tough organic matter, while the remaining two-thirds consists of bone ash. Bone ash has about the following composition:—

Lime	51 per cent.
Magnesia	2 ,,
Phosphoric acid	38 ,,
Carbonic acid	4·5 ,,
Other substances	4·5 ,,
	100 0 per cent.

The other substances consist of small quantities of potash, soda, iron, fluorine, sulphuric acid, and silica. The phosphoric acid exists in the ash mainly in the form of tricalcium phosphate or the tribasic phosphate of lime. This phosphate is often called bone phosphate. A part of the phosphate in bone ash is in combination with magnesia, and part of the lime is in the form of carbonate of lime

The bone cartilage is a compound of carbon, hydrogen, oxygen, and nitrogen. Its manurial value is due to the nitrogen, of which it contains about 17 per cent When collagen, whether from bone or from connective tissue, is subjected to prolonged boiling with water it becomes soluble and forms what is called gelatin or, in the coloured impure state, glue This change takes place more readily if it is heated by steam or boiling water under pressure Much bone is treated in this way to prepare glue, size, and gelatin. After the process the bone which is left is known as steamed, boiled, or degelatinized bone.

The manurial value of bone depends on the two constituents phosphate and nitrogen A clean, dry sample of bone contains about 53 to 57 per cent of phosphate, estimated as tricalcium phosphate, and 5 to 6 per cent of nitrogen. Commercial bones, however, contain moisture and small quantities of other impurities, which reduce the phosphate and nitrogen somewhat The following table shows the approximate composition of bones in different states —

Table I

	Green Bones	Cleaned Degreased Bones	Boiled Bones	Steamed Bones
	per cent	per cent	per cent	per cent
Moisture	15-20	7-9	8-10	8-10
[1] Organic matter (including fat)	32-36	25-30	20-25	10-20
Phosphate of lime	39-43	47-53	55-60	60-70
Carbonate of lime	3½-4½	5-8	6-8	7-9
Alkaline salts, &c	1-2	1-2	1-2	1-2
Siliceous matter	½-2	1-4	1-4	1-4
[1] Containing nitrogen	3¼-3¾	3¾-4½	1½-2½	¾-1½

Raw or green bones are collected about towns, and wherever there is a meat-canning or meat-extract-making industry. In this state they contain much moisture and organic matter, as shown in Table I. The high percentage of organic matter, as compared with clean bone, is due chiefly to the fat they contain. They are cleaned, and the grease removed either by a rough process of boiling and skimming or by a benzene extraction process. The latter is the more thorough process of fat-extraction. Bones which are to be used in making glue or size are generally first degreased by the benzene process. After the cleaning and degreasing process the bones are dried, and are then in the state in which they are used in the manufacture of bone meals, bone dusts, and crushed bones. Such bones should contain practically the whole of the natural bone nitrogen of the cartilage. When bones are degreased by boiling, a little nitrogenous matter is extracted by this process; but the amount so removed should be small, and the nitrogen of bones used in making bone meals should not fall below 3¾ per cent, equal to about 4½ per cent of ammonia.

Bone Meals and Bone Dusts.—Bones which have been degreased, but which still contain their natural cartilaginous material, are difficult to grind to a fine powder. In the early days of their use bones were merely crushed between steel rollers, or chopped with strong chopping machinery. Such bones were in a coarse, rough state, and were very slow in their action. They are now used only to a very small extent. With the introduction of improved machinery, it has gradually become customary to grind bones more and more finely, and what were known as inch and half-inch bones are now rarely met with. With modern machinery bones can be ground to any required degree of fineness, though it of course costs a little more to grind bones finely than to turn them out in a rough state. Old customs die hard, and as farmers have long been accustomed to purchase bone manures in a state in which there are pieces of bone large enough to be easily recognized by the eye as bone, they are suspicious of anything which is so finely ground as not to show such pieces. The popular bone meals and bone dusts of commerce are in this state. In these manures a variable proportion of the bone is really ground to the state of a fine dust or flour, but a certain amount still remains in pieces from $\frac{1}{10}$ to ¼ in., or even more, in diameter. Such coarse pieces are too slow in action to be really of much value as manure. The writer has tested a great many commercial samples of bone meal and bone dust over a wire sieve with ten meshes per linear inch. As a rule, from 5 to 20 per cent of the manure failed to pass such a sieve. Exceptional samples entirely passed through the sieve, but these are rarer than coarse samples, of which over 20 per cent failed to pass. What are known as bone dusts generally contain more of the coarse particles than bone meals.

Bone meals and bone dusts are of quite similar chemical composition. They are merely different grists prepared from the same bones. The general composition of these manures is shown in the column headed Cleaned Degreased Bones in Table I. They should contain at least 48 per cent of phosphate, calculated as tribasic phosphate of lime, and at least 3¾ per cent of nitrogen, equal to 4½ per cent of ammonia. These figures represent the usual guarantee given for bone dusts and bone meals. The phosphate may rise as high as 54 per cent, but usually varies between 48 and 52 per cent. Similarly, the nitrogen may rise as high as 4¼ per cent, but is usually between 3¾ and 4½ per cent, and averages about 4 per cent, equal to 4·9 per cent of ammonia. Dirty, impure samples may show lower percentages of phosphates and nitrogen than these. Samples are occasionally met with which contain sand, glass, cinders, brick, and other impurities, which may amount to 10 per cent or even more. The presence of so much impurity reduces the percentages of the valuable constituents nitrogen and phosphates. The following table gives analyses of a number of typical samples of home and foreign bone meals:—

Table II.—Genuine Bone Meals

	Indian Bone Meals		Home Bone Meals	
	1	2	1	2
Moisture	8·87	8·54	8·23	8·52
[1] Organic matter	28·57	29·37	30·52	30·71
Tribasic phosphate of lime	53·17	49·41	49·17	50·69
Carbonate of lime	7·23	7·87	8·03	6·66
Siliceous matter	1·06	2·84	1·92	2·23
Undetermined (alkaline salts, &c.)	1·10	1·97	2·13	1·19
	100·00	100·00	100·00	100·00
[1] Containing nitrogen	3·85	4·13	3·87	4·17
Equal to ammonia	4·67	5·02	4·70	5·07

Bone meals are generally sold as home bone meals, East Indian bone meals, River Plate bone meals, or according to the place of origin of the bones from which they are prepared. It is sometimes supposed that the home bones are of higher value than those of foreign origin. It is, for instance, quite a common opinion that foreign bones are more apt to contain sand, and generally to be more impure and dirty, than home bones. There does not appear to be much ground for these opinions. As a general rule, East Indian bone meals give a rather better analysis than English bone meals. They are, on the average, a little higher in phosphates and quite as high in nitrogen. Some of the grists of foreign bones are apt to contain a good deal of sand, but one quite as often meets samples of home bones which contain insoluble siliceous matters, such as sand, brick, glass, &c. In both cases these impurities are present in the bone on account of the method of their collection and the sources from which they are derived. Quite clean samples of foreign bone appear to be quite as common as clean samples of home bone.

Mixed and Sophisticated Bone Meals.—There are various kinds of mixtures which are not infrequently sold as bone meals which are not really prepared from pure raw bones. First of all there are impure samples, in which the raw bone is mixed with more or less nitrogenous animal matter. Nearly all samples of bone meal are apt to contain traces of such materials as hair, sinew, skin, hoofs, &c.; but in the meals referred to, ground horn or hoof, hair and sinew are mixed with the bone in quite considerable quantities. Such bones are sometimes called 'reinforced' bones They can generally be distinguished by their colour, by the presence of yellow translucent pieces of horn, hoof, or sinew mixed with the white opaque pieces of bone, or by the presence of considerable quantities of hair mixed with the bone Such samples contain a higher percentage of nitrogen and a lower percentage of phosphates than ordinary bone meal. Hair, horn, and sinew in the dry, pure state all contain about 16 per cent of nitrogen and no phosphate. The presence, therefore, of a comparatively small percentage of any of these substances distinctly raises the percentage of nitrogen and lowers that of phosphates

Mixtures of bone with dried meaty substances are sometimes sold as bone meat meal Some of these contain large percentages of dried flesh, hoof, skin, &c., mixed with ground bone Table III gives analyses of samples of reinforced bones and of bone meat meal Both the samples of reinforced bones given in the table were sold as bone meals

TABLE III

	Reinforced Bones	Bone Meat Meal	Liebig's Guano
Moisture	6·66	5·83	5·26
[1] Organic matter	32·69	60·45	47·20
Tribasic phosphate of lime	49·13	24·63	36·25
Carbonate of lime	7·26	1·10	8·37
Siliceous matter	2·13	3·37	1·80
Undetermined (alkaline salts, &c)	1·83	4·62	1·12
	100·00	100·00	100·00
[1] Containing nitrogen	4·65	7·56	6·23
Equal to ammonia	5·65	9·18	7·57

These samples are generally more finely ground than ordinary bone meals or bone dusts Somewhat similar preparations to the above are sometimes made at places where extracts of meat and such preparations are made The bone is ground up finely and mixed with finely divided nitrogenous waste from the manufacture of food products. Such manures are sometimes sold under the name of guano Liebig's guano, an analysis of a sample of which is given in Table III, is an excellent example of this class

Another class of mixture which is sometimes sold as bone meal might be called faked or imitation bone meal. It consists essentially of bone which has been more or less degelatinized, mixed with nitrogenous animal matter such as hoof meal, ground horn, and ground flesh and sinew. As has been mentioned already, the treatment of bone with boiling water or steam removes nitrogenous matter as glue or gelatin. The degelatinized or steamed bone which has been subjected to this treatment contains less organic matter and less nitrogen than ordinary bone. By adding to this hoof, horn, or sinew, the organic matter and nitrogen are restored, and the composition can be made to resemble very closely that of raw bone. The following table gives analyses of samples sold as bone meal which really consisted of mixtures of this kind · —

TABLE IV FAKED BONE MEALS

Moisture	11·60	5·50
[1] Organic matter	31·00	11·69
Tribasic phosphate of lime	48·55	43·73
Carbonate of lime	7·04	4·31
Siliceous matter	1·18	1·19
Undetermined	0·63	0·25
[1] Containing nitrogen	4·27	4·36
Equal to ammonia	5·19	5·28

We have every reason to believe that the nitrogen and phosphates in all these classes of mixtures are unit for unit quite as valuable as those in genuine bone meal. Indeed in many cases they are probably more valuable, for these mixed bones are commonly more finely ground than genuine bone meals. The nitrogen of horn or hoof, for example, is probably quite as available to plants as that of bone, provided the horn or hoof is as finely ground as the bone

Manures such as the bone meat meals and Liebig's guano not only contain nitrogen in a readily putrescible form which quickly becomes available to plants, but they are generally much more finely ground than ordinary bone meals. They form, therefore, excellent manures, which are unit for unit worth at least as much as bones

STEAMED BONE FLOUR As stated above, large quantities of bone are treated with steam or boiling water under pressure to remove a part of the nitrogenous matter for the manufacture of gelatin or glue The bone which is left after this treatment is much more brittle than raw bone, and is much more easily ground to a fine powder Raw bone is not only hard but tough as well, and in the early days of the manufacture of bone manures it was practically impossible to grind it very finely. The use of comparatively coarse bone therefore became customary, and the relics of this practice remain till the present day, although with modern machinery there is no reason why bone should not be ground to any required degree of fineness On the other hand, as degelatinized bone is brittle and comparatively easy to grind to powder, it has always been customary to grind it to a comparatively fine powder, and most of it is sold under the name of steamed bone flour. Steamed bone flour, though one sometimes meets samples a little rough in texture, is generally ground to the form of a fine dust or flour.

Steamed bone flour contains considerably less organic matter and nitrogen and considerably more phosphate than raw bones. As a rule, the nitrogen varies in amount from ¾ to 1½ per cent, and the phosphates from 60 to 70 per cent, but samples of bones which have been comparatively lightly degelatinized are not uncommonly met with. These contain more nitrogen and less phosphates than here shown. On the other hand, one occasionally meets with samples which have been severely steamed, and which contain an abnormally small percentage of nitrogen. Such samples may contain even less than ½ per cent of nitrogen. Table V gives examples of the analysis of steamed bones All the samples the analyses of which are given in the table, were so finely ground that practically everything passed through a sieve having 30 meshes per linear inch.

TABLE V —STEAMED BONE FLOUR

	1 per cent	2 per cent	3 per cent
Moisture	9·68	8·57	8·97
[1]Organic matter	19·39	12·93	21·41
Tribasic phosphate of lime	62·04	68·27	57·31
Carbonate of lime	7·53	8·63	7·14
Siliceous matter	0·62	0·64	1·21
Undetermined	0·71	0·96	0·96
	100·00	100·00	100·00
[1]Containing nitrogen	1·36	0·78	1·96
Equal to ammonia	1·65	0·95	2·37

In the above table, Nos 1 and 2 are analyses of genuine steamed bones. No 3 was also sold as steamed bone flour Probably it is only a boiled bone, as it is not nearly so completely degelatinized as most samples of bone which have been treated with superheated steam

Steamed bone flour is not so popular as bone meal, and therefore is not only cheaper per ton, but is slightly cheaper per unit of phosphate than bone meal

IMPORTANCE OF FINENESS OF GRINDING It is of the greatest importance that bones should be finely ground. Fineness of grinding is of much greater importance than country of origin, and is even of more importance than rich composition in nitrogen and phosphates A bone containing only 3¾ per cent of nitrogen and 48 per cent of phosphates, if it is really finely ground, will be a more active and effective manure than a very rich sample containing 4¼ per cent of nitrogen and 51 per cent of phosphates which is coarsely ground Nevertheless, as a rule, agriculturists in this country continue to demand bones so coarsely ground that a considerable percentage of the sample consists of pieces sufficiently large to be recognized by the naked eye as bone In other countries the custom of using bones comparatively coarse appears to be almost extinct, and it causes surprise that the demand for such bones should continue in this country. The idea which underlies this demand is that bones are used to last throughout the rotation. The practical farmer believes that by using bones comparatively coarse their effect will last for five or six years. But coarse particles of bone will last very much longer than this. Probably very little of the value of coarse pieces will be recovered in five or six years. Some years ago the writer obtained a sample of pieces of bone picked out of a soil to which bones had not been applied for about twenty years. Before that time the soil had been heavily dressed with coarse bone. When these particles were picked from the soil, the advocates of coarse bone contended that all the good had been used up from them, and that these were the mere useless 'shells'. After being washed free from adhering soil, however, these bones gave the following analysis —

Moisture	4·75 per cent.
[1]Organic matter	26·15 ,,
Tribasic phosphate of lime	52·70 ,,
Carbonate of lime	14·40 ,,
Siliceous matter	1·60 ,,
Undetermined	0·40 ,,
	100·00 per cent
[1]Containing nitrogen	3·53 per cent.
Equal to ammonia	4·29 ,,

In other words, they still contained as much phosphate and nearly as much nitrogen as a first-class sample of bone meal.

On the other hand, no matter how finely bones are ground, their action will be continued over a period of a few years They form a slow-acting insoluble manure, the effect of which will not under any circumstances be limited to one season only The general principle is, that in the case of an insoluble manure the more finely ground it is the more effective will be its action and the better will be the return obtained for the money spent on it

The value of fine grinding in bones has been put to the test of experiment, both in this country and elsewhere, again and again For instance, Dr Aitken carried out experiments on this subject for the Highland and Agricultural Society of Scotland many years ago. Experiments made in Germany and America have shown that if bones are so finely ground as to be really in the form of fine dust or flour, weight for weight of phosphoric acid they are as effective or nearly as effective as the soluble phosphate of superphosphate or dissolved bones. On the other hand, the more coarsely ground the bone the slower and less effective the action of both its nitrogen and phosphate. The nitrogen and phosphate of bones are both insoluble in water, and there is no danger that they will be lost in the drainage, no matter how finely the bones are ground.

The writer has for several years carried out experiments on the turnip crop in which bones of different degrees of fineness have been used; the results of some of these experiments are shown in Table VI.—

TABLE VI --EFFECT OF FINENESS OF GRINDING OF BONES IN TURNIP CROP PER ACRE

	1st Season Average of 4 Experiments		2nd Season Average of 6 Experiments.	
	tons	cwt	tons.	cwt.
1. No phosphate . .	5	15¾	9	18
2. Coarse bone meal, 5 cwt. .	14	0	15	17½
3. Fine bone meal	16	17¼	17	12¼
4 Steamed bone flour.	18	1	17	10¾

All the plots of the experiments in both seasons were equally manured with soluble nitrogenous and potassic manures, but none of them received any dung. The differences in the crops were therefore due to the differences in the phosphatic manuring. No phosphate at all was given to the first plot, the other three each received an equal amount per acre of phosphoric acid. In No. 2 this was given in the form of 5 cwt. of coarse bone meal, while No. 3 received about 5 cwt. of fine bone meal, and No. 4 about 4 cwt. of steamed bone flour, the exact amount in each case being regulated by analysis, so as to give an equal dressing of phosphate to each plot.

The bones given to No. 2 were not out of the common in coarseness. They were not specially ground for the experiment, but were a rough commercial sample. In the first season 44·5 per cent failed to pass a $\frac{1}{10}$-inch sieve, while an additional 32·3 per cent failed to pass a $\frac{1}{30}$-in. sieve. In the second season 36·6 failed to pass the $\frac{1}{10}$-in. sieve, and an additional 50·2 per cent failed to pass a $\frac{1}{30}$-in. sieve. The fine bones were by no means ground to flour, but in both seasons were ground till all passed a $\frac{1}{10}$-in. sieve. In the first season 39·4 per cent, and in the second season 17·9 per cent, failed to pass the $\frac{1}{30}$-in. sieve. The steamed bone flour was ordinary commercial steamed bone flour, and in both seasons all but a small percentage passed the $\frac{1}{30}$-in. sieve.

The results in the table show that in the first season the crop was larger the more finely the bone was ground. In the second season the fine bones gave again a larger crop than the coarse bones, but the average crops from the fine bones and steamed bone flour were practically equal. Even in this case, however, the steamed bone flour has the advantage, as it cost about 8s. per acre less than the fine bone meal. Not only was it cheaper per ton than the bone meal, but a smaller dressing per acre was applied.

An argument sometimes used by farmers to justify their purchase of comparatively coarse bone is that they like to see that it is bone, and that if it were very finely ground they could not be sure whether it is pure bone or not. But in the case of other manures they cannot tell by appearance whether they are genuine or not. They cannot tell merely by appearance whether, for example, basic slag, or steamed bone flour, or sulphate of ammonia is pure. They have to trust to the protection of the Fertilizers and Feeding Stuffs Act and to an occasional analysis to safeguard them, and there is no good reason why bones should be made an exception in this.

Up to the present time the highest demand which is ever made with regard to bones is that they should pass a $\frac{1}{10}$-in. sieve. If a sample is ground till it entirely passes such a sieve, it is considered to be very finely ground. The ideal requires to be raised to a much higher standard than this. At present, even in the case of the most finely ground samples, a considerable proportion of the bone will not pass a $\frac{1}{30}$-in. sieve. A really well-ground sample should entirely, or almost entirely, pass such a sieve.

FERMENTED BONES.—Bones are sometimes fermented in order to render them more available as manure. In former times, when bones were more coarsely ground than at present, this practice was much more common. The crushed or roughly ground bones were made into heaps and moistened, and allowed to heat. Some readily fermentable substance, such as urine, and especially horse urine, was often used for moistening them, and a further dressing of urine was added from time to time. When treated in this way the bones were thoroughly disintegrated in the course of a few weeks, and were rendered much more effective as a manure. It is said, however, that a good deal of nitrogen was apt to be lost during the fermentation, especially if the heating was considerable. This method of treating bones is now seldom used.

DISSOLVED BONES.—Dissolved bones are made by treating bones with sulphuric acid. It was first suggested by Liebig that insoluble phosphates might be made soluble, and therefore more effective as manure, by treatment with acid. Bones and bone ash and bone char appear to have been treated with acid a few years before the manufacture of mineral superphosphate began (see ARTIFICIAL MANURES and SUPERPHOSPHATE). In the early days of their manufacture dissolved bones were called bone superphosphate, and this term is occasionally used at the present day. At present, however, what are known as bone superphosphates are generally made from bone ash or bone char.

It is impossible to render the whole of the phosphate in raw bone soluble in water without at the same time making the product too pasty for use. In dissolved bones, therefore, we never find more than two-thirds of the phosphate soluble in water. As a rule, only about half is water soluble, and in many samples only from one-third to a half of the phosphate is water soluble, while from two-thirds to a half is insoluble in water. At the same time the portion of the phosphate which is insoluble in water is rendered more available to plants than the insoluble phosphate of untreated bone. The whole structure of the bone is disintegrated by the acid, and much of the phosphate which is not turned into soluble or monocalcium phosphate is turned into dicalcium phosphate, which is sometimes called reverted phosphate. Nearly the whole of the insoluble phosphate of dissolved bones is soluble in dilute citric acid, and compares in availability with the phosphate of basic slag. The disintegration of the bone by the acid also renders the nitrogen more active and available than that in bone meal.

Dissolved bone is a very active and valuable manure, but there are two great objections to its use. (*a*) it is very dear, and (*b*) it is very liable to adulteration. On account of the cost of raw bones themselves, and the cost of the treatment with acid to render them soluble, dissolved bones are necessarily an expensive manure in comparison with most others. It is easy to make up from mineral superphosphate, steamed bone flour, and some nitrogenous material, such as ground horn or sulphate of ammonia, a mixture which will have the same composition and manurial value as dissolved bones, at considerably less cost. The result is, there is a great temptation to mix cheaper substances with bones, especially as, when such mixtures are made with even a moderate degree of skill, it is almost impossible to detect them. Cheaper mixtures, which are equally effective, have now largely replaced dissolved bones, which are used to a much less extent than formerly.

Before the Fertilizers and Feeding Stuffs Act of 1893 was passed, it had become a common custom to sell as dissolved bones mixtures which contained practically no dissolved bones, but in which the whole, or nearly the whole, of the soluble phosphate was derived from mineral superphosphate. Such mixtures usually contained a quantity of comparatively coarsely ground bone meal in the undissolved state. They were really manure mixtures made from superphosphate and bone meal, along with more or less nitrogenous organic matter, and sulphate of ammonia. Before the Act was passed there was a danger that the sale of such mixtures under the name of dissolved or vitriolized bone would become established as a trade custom. After the passing of the Act these mixtures were called dissolved-bone compounds, and it is under this name that they are commonly sold at the present time. It seems open to question whether they are entitled to this name any more than the other. The name implies that they are compounds containing dissolved bone. Very often these mixtures contain no dissolved bone at all, and some of them contain little or no bone of any kind. Even those which contain some raw bone generally contain only sufficient comparatively coarse bone meal to make a show of pieces of bone in the mixture sufficient to justify the use of the name 'bone'.

In the following table some analyses of dissolved bones and of dissolved-bone compounds are given:—

TABLE VII. DISSOLVED BONES AND DISSOLVED-BONE COMPOUNDS

	Dissolved Bones		Dissolved-Bone Compounds
Moisture	11.15		–
[1] Organic matter and combined water	29.51		
[2] Soluble phosphate (as tribasic phosphate of lime)	12.74	17.39	22.61
Insoluble phosphate (,, ,, ,,)	25.13	18.64	3.61
Sulphate of lime	22.93	– –	
Siliceous matter	2.49	–	
[1] Containing nitrogen	2.85	2.29	1.19
Equal to ammonia	3.46	2.72	1.41
[2] Equal to monocalcium phosphate	9.62	13.13	17.07

BONE ASH AND BONE CHAR. Bone ash and bone char are chiefly used in the manufacture of superphosphates, which are sometimes called bone superphosphates. Bone ash is mainly imported from abroad. It consists largely of tribasic phosphate of lime, of which a good sample will contain over 80 per cent. In the undissolved state, in which it is occasionally used as manure, it has no greater value than a mineral phosphate, such as Algerian phosphate. Purchasers therefore should not pay a higher price per unit for it than that at which they can buy ground Algerian phosphate.

A great deal of bone is treated by destructive distillation to prepare bone charcoal, which is also known as bone black or bone char. This substance is used in sugar-refining and for other purposes, and after being so used is known as spent char. The spent char is then passed on to the manure manufacturers and made into manure (see BONE BLACK). [J. H.]

Bone Meal. See BONE MANURES.

Bone Mill.—The powerful mills employed to crush and reduce bones to a meal are usually of three types. (1) Toothed-ring grinding with gradual reduction; (2) toothed-roller grinding, (3) collision grinding. The Devil Disintegrator, made by the Hardy Pick Company, is an instance of the first. The grinding rings, one fixed and the other revolving, are fitted with teeth arranged in concentric circles, so that the teeth on one pass through the space between those on the other, breaking the bones by collision and also with a shearing action; performing most satisfactory work. Nicholson & Sons', consisting of two pairs of toothed grinding rollers, one coarse and the other of finer pitch, set one above the other, as in many cake mills, is also a very satisfactory mill. Collision mills, in which stout revolving beaters smash the bones against the inner periphery of a cylinder; while doing fair work with bones are probably better suited to substances which fly readily, and are therefore very popular in the reduction of ores. Small machines for reducing green bones for poultry-feeding are being increasingly used by poultry-keepers, the value of this food being better recognized. In Bentall's machine the bones are placed in the cylinder and forced against the knives by a presser plate, the steel knives are adjustable to cut fine or coarse, and fit into cutter plates which revolve in the bottom of the open cylinder covering the knives. [W. J. M.]

Bone Spavin is a disease of the hock, and it would not be untrue to say that in the majority of horses lame behind, the trouble is in the hock; the reason being the complex nature of the joint; and this intricacy, although admirable for the purpose for which it was intended, viz. the reduction of concussion to other parts of the limb, is in itself a predisposing factor to disease, and one that is largely influenced by conformation, good or otherwise. The disease is due to a chronic inflammation of the joint, but the exact point of origin of this inflammation is a matter of much debate; some authorities declaring that it starts within the joint itself, in the articular cartilage, and works outwards, whilst others affirm that the periosteum, or thin membrane covering the bones, is the starting-point from whence the disease gradually works inwards. In either case the end is the same: ossification of the diseased parts takes place, followed later by a bony union, or *anchylosis* as it is termed, of two or more of the tarsal bones themselves; and until such union takes place, either naturally or hastened by remedial measures, lameness persists. Spavin (by which is always meant bone spavin) is therefore an inflammatory affection of the hock, characterized by bony formation, usually external, and generally situate on the antero-internal portion of the joint, or confined entirely to the interior, and consequently invisible from the outside. Of the two forms the latter is by far the most serious, and is known as occult spavin. It is the hardest to diagnose correctly, for there is nothing to see, and often nothing to feel.

The symptoms of spavin are lameness, in which the toe is dragged, the hock 'carried', that is to say, not properly bent, and the quarter of the affected side is also carried higher from the increased effort necessary to clear the foot of the affected limb from the ground. The lameness usually wears off to some extent with work, but gets as bad as ever after standing for half an hour, and varies often from day to day. On forcibly flexing the joint, pain will be evinced, and if the leg is grasped around the cannon bone, and held close to the flank for a minute or so, then dropped, and the horse immediately jogged, the lameness is aggravated, the step is short, and turning sharply round towards the sound side seems to increase the trouble; in long-standing cases there is certain to be some atrophy of the muscles of the hip and quarter.

Usually there is heat present, and there may be an enlargement visible somewhere on the inside and towards the front of the joint, but great care must be taken, or mistakes may very easily be made. It is not sufficient to say that because there is a slight difference between the two hocks spavin is present; and unless there is a distinctly appreciable difference between the two joints, and lameness apparent, or an interference with the proper flexing of the joint, such appreciable difference by itself may not constitute a spavin, for it may be due to an inequality between the ridges present on the outside edge of some of the bones, such as the scaphoid and the cuneiform. The anchylosis may take place between any of the bones, but usually occurs between the metatarsal and the scaphoid, or scaphoid and cuneiform.

In internal or occult spavin, where nothing in the shape of an enlargement is to be seen or felt from the outside, diagnosis is more difficult, and is often arrived at by what is known as the negative process, that is, by excluding every other possible cause or seat, until the hock alone is left; but usually in these cases the lameness does not get better with exercise, but rather the reverse. Flexing the hock will cause pain, but care must be taken here as before to grasp the limb by the cannon bone, not by the toe of the hoof, so as to avoid being misled by any possible affection of the fetlock joint which might be present.

Possibly there is no point on which authorities are so much divided, and around which controversies wage so strong, as the diagnosis of spavin; certainly there is no point on which more care should be exercised or more minute attention given to every detail in examining.

Age and conformation have a great deal to do with the formation of spavin; it is more common in the comparatively young than the old, and amongst those animals with weak, badly formed hocks, especially those that taper unduly towards the lower extremity, and those that are placed too far back. Wide hips are conducive to it, but a large bony hock usually wears well.

In the treatment of spavin the first thing is rest, and unless this can be assured all treatment must be useless; and if the rest be of sufficient duration it may prove, in many cases, the only treatment necessary to procure a sound gait, perfect cure there never can be, for it is impossible to restore the articular cartilage or the periosteum to its normal state. The aim of all treatment is anchylosis, when this is attained, lameness ceases.

One of the commonest forms of mild treatment is the application of a blister, such as cantharides (1 part of the powdered cantharides to 4 of lanoline or lard) and the biniodide of mercury (1 part to 8 of lanoline or lard), if a stronger is required, croton oil or the concentrated sublimate solution may be used. Beyond the rest thus obtained, there is not much lasting benefit from them; the patient may come up sound, but after a short period of work he frequently falls lame again.

Division of the posterior tibial nerve has been advocated by some, but is of doubtful benefit, since the nerve in question is not the only one supplying the hock, and consequently the excision of a portion of it will not ensure loss of sensation to the joint, and in those cases where it has been tried and reported a success, probably the lameness was to some extent due to other cause than spavin.

Periosteotomy, with a view to causing exostosis on the edge of the joint and so hastening union, has been strongly advocated by Peters, and has lately been practised by Moller, who divides the internal lateral ligament and the inner tendon of the flexor metatarsi, and claims good results.

Probably the best all-round treatment is line firing and subsequent blistering with the biniodide of mercury (1 part to 8 of lanoline or lard); the firing should either be fairly deep and not too close together, or shallower and the lines more numerous; the pattern chosen is immaterial, so long as it covers the joint and any exostosis present. The hair should be clipped off closely, and if very scurfy the skin should be washed and subsequently dried. See BLISTERING.

It is generally advisable to cast the animal on some convenient place, as few horses will stand for the proper performance of the operation, and it is also usual nowadays to administer an anæsthetic, such as chloroform. The blistering can be done after the patient gets up; and he should be tied up with a couple of good ropes (chain and leather pillar-reins are apt to snap and should never be used for this purpose) for four or five days, when an emollient dressing of Goulard's extract (1 part) and olive oil (6 parts) may be lightly rubbed in, and the head let down, after which, if he seems inclined to leave the part alone, he may be turned out (if the season permits), or roughed up in a straw-yard or box for three months, any shorter period is not of much use; and even at the end of this time, on trying or working for a short time, lameness may reappear, and a further rest becomes necessary, and possibly a repetition of the treatment.

It is not an uncommon thing for a horse to be lame from spavin for one or two years and eventually become sound, treatment being continued the whole of the time. For saddle purposes a horse with a spavin, no matter what his age may be, should never be bought. He *may* go sound, but there is a very much greater chance of his becoming lame. For harness purposes, if he is seven or eight years of age, uses the affected hock freely, and is otherwise suitable, the risk may be entertained, as there is a likelihood of his working sound for years.

[H. L.]

Bones, Dissolved. See BONE MANURES.

Bookkeeping, Farm. See ACCOUNTS.

Bookkeeping for Woodlands. See WOODLANDS, BOOKKEEPING FOR.

Booth, Thomas. The name of Booth is one which has been associated with the breeding of Shorthorn cattle for over a century. As far back as 1790 Thomas Booth owned and farmed the beautiful estate of Killerby, in the fertile valley of the Swale, and of Warlaby, in the vale of the Wiske (Yorkshire). Here he founded the famous 'Booth' strain of Shorthorns, which became so remarkable for its fattening capacity. The foundations of his herd were drawn from that of the Colling brothers, his idea being to cross bulls strongly bred and of moderate size from that source upon large-framed cows of exceptional constitution and aptitude to fatten. See SHORTHORN CATTLE.

The life of Thomas Booth was almost wholly bound up in his agricultural and breeding operations. He did not perhaps possess the versatile gifts of his contemporary Thomas Bates, but he certainly lacked none of the qualities that denominate the great judge and breeder and improver of stock. He stands in the front rank of early Shorthorn breeders, and as such appeals to the Shorthorn enthusiast. He is remembered as an honest and straightforward, if somewhat plain man. In the latter years of his life he resided at Warlaby, where the family traditions are still maintained by his great-grandson. [J. B.]

Borage. — The common Borage (*Borago officinalis*) is indigenous to the East Mediterranean region, but has long been cultivated in European gardens, and has become naturalized in several counties in England. It is an annual from 12 to 18 in. high, with oval hairy leaves, numerous stems, bearing cymes of blue or sometimes purple flowers, pretty enough to rank among decorative border plants. The flowers are used for garnishing salads, but the plant is grown for the manufacture of cordials and for making claret cup. It is grown in frames for the autumn and winter supply, at other times in the open border, the seeds being sown in spring. Once established in a garden it is not easily eradicated, as the seeds which are ripened freely, germinate in any out-of-the-way corner. [W. W.]

Borage (*Borago officinalis*)

1, Section of Flower

Borax. See BORIC ACID.

Bordeaux Mixture is the name given to a poisonous substance used for spraying plants infected with fungoid disease. Such substances are called fungicides, and are used in combating fungoid attacks upon plants. Bordeaux mixture derives its name from the town in France where it was first used. The poisonous substance in it is copper hydrate. Compounds of copper in small quantities have long been known to exert a poisonous action upon fungoid growths and their spores. For this reason they were used largely at first in order to prevent the ravages of the vine mildew. The mixture is made by adding milk of lime to a solution of copper sulphate. Different proportions of these substances have been used in making Bordeaux mixture. The weight of copper salt varies from 12 to 30 lb., and the lime varies from 8 to 20 lb. per 100 gallons of water.

Copper sulphate, blue vitriol, or blue stone dissolves in water, forming a solution with an acid reaction. If such were applied directly to plants, it would burn or scorch the foliage. By adding lime the copper is all precipitated as a light-blue substance, namely the hydrate, and the acid properties of the solution are thereby destroyed. Care should be taken that all the copper is present in the form of the hydrate, which has no burning action upon the foliage. This can be done by adding excess of lime. When that point is reached, the solution would give an alkaline reaction. Another way of telling is to breathe on to the surface of the liquid and a film of chalk will be formed. For further particulars of this substance the reader may consult the article on FUNGICIDES.

[R. A. B.]

Border.—This term is used for the cultivated portions of a garden as distinguished from the lawn and the formal bed. In the kitchen garden it is that portion which extends along the outside, usually under the wall or fence, and is known either as the fruit, strawberry, or herb border. In the decorative garden the border is that portion usually on the outskirts of the garden, and devoted to the cultivation of a variety of plants. Thus we have the shrub border, the rose border, the herbaceous border, and so on. The border garden is too often a kind of hodge-podge, lacking in interest and receiving very little attention, whereas it ought to be the most interesting part of the garden, if a judicious selection of suitable plants, tree, shrub, and herbaceous, were made, and these all carefully cultivated with a view to their proper development. The herbaceous border has in many gardens become an interesting feature in consequence of greater attention being given to its planting and after-management. But the shrub border is still in most gardens a neglected feature, notwithstanding the great variety of beautiful hardy shrubs that are now available for its adornment. To obtain the best results from borders they require to be thoroughly overhauled periodically, every spring in the case of herbaceous plants, and at least every three years in the case of shrubs, rhododendrons, roses, &c. Herbaceous plants should not only be lifted and the ground dug over and manured, but every plant should be carefully examined, breaking up the clumps that have become too close, and replanting only the younger portions, or if larger clumps are desired, every piece can be replanted in a way to afford more space for development. Some most beautiful effects can be obtained by a proper arrangement of suitable plants in the herbaceous border. It should not be limited to such commonplace plants as Michaelmas Daisies, perennial Sunflowers, Golden Rods, and the commoner annuals; there are so many lovely plants nowadays, such as Kniphofias, Lilies, Pæonies, Phloxes, Pentstemons, Gladioluses, Carnations, Delphiniums, Columbines, Day Lilies, Spiræas, Foxgloves, perennial Poppies, and so on. These plants are to be obtained at little cost, and if planted with judgment and afterwards attended to as here recommended, the border containing them becomes a feature of perpetual and ever-changing charm. The selection of plants should be made with a view to a lengthened display. The flowers of spring and late autumn should be included, as well as those which are the glory of summer. In small gardens the combination of shrubbery and flower border is often preferred, and if properly planted this border is a garden in itself. The shrubs, with here and there a small tree, such as a Pyrus, Laburnum, or Lilac, should be irregular in height and varied in habit, a selection, for instance, like the following.—Rhododendron, Broom, Forsythia, Deutzia, Mock Orange, Hydrangea, Spiræa, bush Rose, Hibiscus, Cydonia, Berberis, Ribes, Yucca, Magnolia, Tamarisk, Heath, Mollis and Ghent Azalea, Japanese Maples, Ceanothus, and Cistus. These should occupy the back portion of the border, but not in a straight line, on the contrary they should be irregular, forming here and there bays in which the herbaceous plants should be grouped. There is no place in such a border for the hungry uninteresting Privet, Cherry-Laurel, Aucuba, Box, Yew, Holly, and such like comparatively dull subjects. They have their value, of course, but not in the small garden. Where Roses are planted in such borders they should be in groups of at least half a dozen of the same kind.

[W. W.]

Border Leicester Sheep.—Everyone who has made a study of the history and improvement of the several breeds of British live stock is well aware of the fact that that improvement must be, to a large extent, if not wholly, laid to the credit of one man—Robert Bakewell, who was born at Dishley, Leicestershire, in 1726, and died in 1795. He was the pioneer of the movement, and it is to him and to the influence he brought to bear upon other breeders of his own and the immediately succeeding generations that the breeders in this country to-day owe their proud position of supremacy in the live-stock world. An account of the history of almost any British breed would be incomplete without a reference to Bakewell's work; of a certainty would that be so in the case of the breed under review.

That he was a man gifted with more than common acuteness of observation, judgment, and perseverance must be admitted on all hands. When he unremittingly applied such qualities to the attainment of one object, success was bound to follow—not necessarily at first, for doubtless he had failures and disappointments, and encountered many difficulties; but his indomitable perseverance bore him supreme over all these, until at length he had achieved such a measure of success that before he had reached the prime of life Dishley became the visiting place not only of enthusiastic home breeders, but of British peers and Continental potentates, all anxious to learn from his own lips the methods he pursued, and to see for themselves the wonderful results he had obtained.

Among the earliest of Bakewell's many visitors were two pairs of brothers from the north of England. Firstly, Charles and Robert Colling, who took home to their farms near Darlington specimens of the Dishley Leicester Sheep in the concrete, and in the abstract a profound admiration for Bakewell's methods, which they proceeded to put into operation upon the cattle of the Darlington district, and thereby produced a distinct type of animal, from which has been evolved the present-day Shorthorn. The second pair of brothers consisted of George and Matthew Culley, who became pupils of Bakewell, and upon returning to Northumberland to take up farming, in 1767, also took with them some of the Dishley sheep. Further reference will be made to this 'connecting link' between the Dishley and the Border Leicesters, but in the meantime let us return to Dishley and enquire what were the guiding principles which enabled Bakewell to achieve such remarkable success, and gave him such widespread reputation as an improver of live stock. We are told by some of the visitors to Dishley that Bakewell discoursed enthusiastically upon his favourite theme, and laid down with emphasis the axioms which must be respected by anyone who wished to become an improver of stock. He related how in his early days it was the common custom among farmers to send to the butcher the sheep that matured most quickly, while those that could not be fattened within reasonable time were retained for breeding purposes. His keen foresight enabled him to see that, if he were to succeed, this procedure must be reversed, and that he must breed only from those that were likely to come to maturity quickly those that would produce the most mutton for the amount of food consumed. His careful observation had led him to the conclusion that the kind of sheep for this purpose was the one of 'circular formation', or, in present-day language, 'well-sprung ribs'. Having selected the sheep that most nearly approached his ideal, he bred from them with a ruthless disregard of the laws of consanguinity, until he produced an improved breed of sheep of a distinct type, and with such overpowering prepotency that they could not fail to impress their outstanding characteristics upon any other breed with which they might be mated.

This, then, was the type of sheep which the Collings and the Culleys took to the north of England. Naturally, of course, Bakewell's neighbours were anxious to avail themselves of some of the benefits to be derived from using his sheep, and high prices were paid not only for the purchase but for the hire of Dishley rams. Culley has placed it upon record that for the services of one ram Bakewell took in forty ewes from each of two breeders at a fee of 10 guineas per ewe, and that in addition he gave the same ram forty of his own ewes, so that putting these at the same fee this ram earned for his owner in one year 1200 guineas in service fees. In addition to the Collings and Culleys, a number of other northern breeders either purchased or hired Bakewell's rams. Prominent amongst these were such men as Mason of Chilton, Dinning of Elford, Jobson of Turvelaws, Thompson of Chillingham Barns, Compton of Old Learmouth, and Robertson of Ladykirk. The Culleys, as soon as they had got their flocks firmly established at Fenton and Wark, followed the same lucrative practice as Bakewell, and annually disposed of a number of rams and ewes to breeders on both sides of the Border. Again, at the time of Bakewell's death in 1795, a number of his neighbours formed themselves into the Bakewell Club, and bought up his sheep with the avowed object of maintaining their purity. From different members of that club the Border breeders continued, until about 1850, to hire rams at prices varying from 50 to 200 guineas for the season. Mention of these extraordinary prices leads the writer to remark here that, by the courtesy of the representatives of the auctioneer who conducted the sale, he recently had the privilege of perusing the list of prices obtained for Dishley Leicesters at Robert Colling's dispersion sale at Barmpton in 1818. At that sale thirteen shearling rams realized an average price of 40 guineas, the highest price being 156 guineas and the lowest 13 guineas, while 105 ewes were sold at prices varying from 20 to 61 guineas for pens of five.

This leads us to an important question affecting the purity of the breeding of Border Leicester sheep which may now be asked. With what object in view did these northern breeders give such extraordinary prices for the hire of rams? Was it for the purpose of breeding pure Leicesters, or for crossing with some other breed? Before supplying an answer to this question, let it be remembered that when the Culleys introduced Dishley sheep into Northumberland in 1767 they brought both rams and ewes, and that very soon afterwards they began to hold an annual sale at which they disposed of both rams and ewes. It may therefore be safely assumed that both in Northumberland and in the south-eastern counties of Scotland a number of small flocks of pure Leicesters were gradually established during the last quarter of the 18th century. The further fact that in many cases a ram was hired jointly by two neighbouring breeders points to the evident conclusion that at all events the majority of the high-priced rams were mated with pure Leicester ewes and were not utilized for crossing purposes. To strengthen this conclusion two examples may be given. Take the case of the flock originally established not later than 1795 by Mr. Thompson at Bogend, removed by his descendants about 1833 to Mungo's Walls, near Duns, and finally dispersed there so recently as 1903. The records of that flock show that at its foundation gimmers were bought from breeders of Dishley sheep, that rams were hired from the Culleys and other northern breeders, and thereafter for a series of twenty-five years from one member of the Bakewell Club, and for ten or twelve years afterwards from another member of that club, until the time came when purchases were made from flocks of Border Leicesters which are still in existence. Surely a record of pure enough breeding! The other example is furnished by the flock owned by Lord Polwarth of Mertoun, and originally founded by the present owner's ancestor, Hugh Scott, afterwards Lord Polwarth, about the year 1790. It is recorded that Mr Scott purchased both ewes and rams from Bakewell, was in the habit of hiring rams from him, that he also made purchases from Culley, Jobson, and other northern breeders, and that since 1856 no extraneous blood has been introduced into the flock. While it was the fairly common practice up to about 1830 for northern breeders to use rams bred in the south, from that date onwards the practice was gradually discontinued, until by the middle of the century it was altogether abandoned. This was due to the fact that the Leicesters bred in the north had slowly but surely become less and less like those bred in the south—in fact they had become quite a different type of sheep. As a consequence a good deal of jealousy was aroused between the northern and southern breeders when both types of sheep were shown in the same class at the meetings of the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland. The question was often raised as to which type was the true representative of Bakewell's Leicesters, but it was never satisfactorily answered, as the show yard decisions depended upon whatever party was in the majority on the judicial bench. Charges of crossbreeding were made on both sides without any possibility of them being substantiated. But when we remember the difference of soil, of climatic conditions, and of the system of feeding, and, above all, the different predilections of breeders, it would have been a matter of surprise if a different type of sheep had not been evolved. It was therefore unnecessary to dispute the fact that both types were directly descended from Bakewell's Leicesters. The friction between the two sections went on increasing, and the northern breeders, styling their sheep 'Border Leicesters', began to bring pressure to bear on the Highland and Agricultural Society of Scotland to provide separate classes for Leicesters and for Border Leicesters. This necessitated a good deal of agitation, but it was ultimately conceded, as the records of the Highland and Agricultural Society show that while classes were provided for Leicesters only up to the year 1868, classes for both sections were provided from 1869 to 1872, for Border Leicesters only in 1873 and 1874, for both sections from 1875 to 1881, and since that date for Border Leicesters only.

Nevertheless the addition of the word 'Border' has led many people to conclude that the Border Leicester must have been produced originally by crossing the Dishley Leicesters with some Border breed of sheep. An attempt has already been made (it is hoped successfully) to show how the appellation 'Border' came to be given, and how the difference in type was brought about by natural rather than artificial causes. But some writers even to the present day maintain that the pure-white face and legs of the Border Leicester could only have been secured by an admixture of Cheviot blood. No evidence is adduced to prove this, and a little consideration will show that there is absolutely no ground for assuming it. In the first place the Dishley Leicesters were whiter than the Cheviots, as it was not at all uncommon about the middle of last century to see Cheviots with grey or dun faces and legs. In this connection it may be remarked that at the Newcastle meeting of the Royal Show in 1864 an exhibitor of Leicesters stated that the sheep he was showing were *pure* Dishley Leicesters, and had been 'in-bred' from the time of Bakewell's death; that these sheep were seen and particularly noted by the writer's father, who declared that their faces and legs were perfectly white. Hence there is no necessity to look far afield for the white points of the Border Leicester. In the second place, if the Cheviot cross had been introduced the tendency would have been to make the Border Leicester smaller than the Dishley, whereas the reverse is the case. And in the third place, the Cheviot is deep and round in the belly, while the Border Leicester is more drawn up in the belly than the Dishley Leicester. When all these points are taken into consideration, there can be no room left for doubting the purity of Border Leicesters as direct lineal descendants of the Dishley Leicester.

Having thus traced the early history of the breed, let us now turn our attention to the appearance and general characteristics of its typical specimens. For this purpose a description may be given of a shearling ram as he would appear in the show yard or sale ring at from sixteen to eighteen months old. He will measure about 32 in. in height at the shoulder, and 40 in. in length from the crown of the head to the tail. He has a wide, level back, well and evenly covered with mutton that is firm to the touch. His width of back he owes to the fact that his ribs are well sprung—a flat rib, in this as in other breeds, is discounted. This spring of his ribs enables him to carry his stomach high, so that his underline is almost as straight as his back. The head is all-important, too strong a head is an indication of coarseness, as too weak a head is of delicacy. It should, nevertheless, be thoroughly masculine in character, with smooth crown, ears evenly set on, and neither drooping nor too much cocked; with clear, bold eye, and wide, dark nostrils. A pink or white nose is regarded with much disfavour as being indicative of a weak constitution, but at the same time it has to be noted that breeders experience great difficulty in keeping clear of it. The skin of the head should be of a pale-pink colour, and covered with pure-white hair. Occasionally a black spot will appear on the head or ears, and, while this may not be regarded as a serious blemish, it is not encouraged by breeders. The neck, tapering nicely from the head, should be strongly set in at the shoulders—there must be no slackness at the junction, giving the impression that the neck and shoulders had been made at different times. The shoulders should slope gently to the ribs, and thus avoid narrowness round the heart. The loin should be wide and firm, and the quarters long and deep. The legs must be squarely set under him, strong, with clean, flat bones, covered with perfectly white hair and quite free from wool. The whole body should be evenly covered with wool of equal quality and comparatively fine staple—curly, but not open to the skin. If he has all these desirable characteristics he will be evenly and symmetrically balanced at every point, with the result that he will be able to move freely and carry himself in a gay and majestic manner that suggests that he has attained such a high degree of perfection of motion as is equalled by few and is surpassed only by his female relative.

The above description of a shearling ram is to a large extent equally applicable to a shearling ewe or gimmer, except that she must, of course, be distinctly feminine in appearance While she is sweeter and milder in countenance, and less strongly built than the ram, she must not by any means present such an effeminate appearance as would be antagonistic to the possession of a sound and robust constitution. It need only be added that a first-rate Border Leicester gimmer affords the most perfect picture of beauty and symmetry that is to be found in the whole sheep world

To turn now to the distribution of the breed As their name implies, they are to be found in greatest numbers in the south-eastern counties of Scotland On the south side of the Border they are largely bred in Northumberland and Cumberland, and to a more limited extent in Durham, Yorkshire, and Westmorland. Numerous flocks are to be found in the western counties of Scotland, south of Glasgow, while their sound and healthy constitution has secured for them quite a number of enthusiastic breeders also in the midland and north-eastern counties of Scotland. In fact, as far as Scotland is concerned, it may safely be said that the only districts in which Border Leicesters are not bred are those comprised in the western Highlands In Ireland they have made great advances in popular favour of recent years, and there are now upwards of twenty-five registered flocks maintained in that country. About 100 rams and ewes are reported annually to foreign and colonial countries, chiefly New Zealand and Canada This wide distribution clearly justifies the statement that no other pure breed of sheep has to so large an extent adapted itself to such variations of soil and climate as the Border Leicester. So long as they are not grazed too closely, and provided that the land is naturally dry, they can be bred, and they will thrive on land of medium quality, even though the situation is high. They have been successfully reared at an altitude of 800 to 1000 ft. above sea level.

The yield of mutton produced by sheep at a year old varies from 100 to 120 lb. It may be at once admitted, however, that no admirer of the breed, however prejudiced, would claim that the mutton of the Border Leicester is of first-rate quality, and the question naturally arises: For what purposes are such large numbers reared? The answer to that question is that the production of rams is the chief object which breeders have in view. It has been computed that fully 7000 shearling rams are sold annually at the various sales, which are held usually in the month of September. By far the most important of these sales is that organized by the Border Union Agricultural Society at Kelso, at which all the best specimens of the breed are disposed of. Other centres at which large numbers are sold are Edinburgh, Perth, Aberdeen, Glasgow, Ayr, Carlisle, and Rothbury. It is estimated that not more than 500 of the rams sold are mated with pure-bred ewes It follows, therefore, that the great majority are used for cross-breeding purposes. This is the kernel of the situation, this explains the marvellous popularity of the breed.

The most important cross is that produced by mating the Border Leicester ram with a Cheviot ewe The offspring is what is known as the 'Half-bred'—a type of sheep which commands such respect that separate classes are now provided for them at the Highland and other leading shows in Scotland. The half-bred ewe is the great commercial stock ewe of the lowland arable farms of the south of Scotland and the north of England. They are bred on the high-lying farms where Cheviot ewes are kept, the general practice being to cross the Cheviot ewe with the Border Leicester ram after she has reared two or three crops of Cheviot lambs. The half-bred wedder lambs are fed off on turnips, while the ewe lambs are sold at such centres as St. Boswell's, Kelso, Duns, Peebles, and Reston, the top price usually being from 38*s.* to 40*s.* per head, although in 1907 one lot at St Boswell's was sold at the extraordinary price of 47*s.* per head. From them three or four crops of lambs are taken, and then they are sold as draft ewes to farmers who keep a 'flying flock', taking one crop of lambs from them, and disposing of both ewes and lambs to the butcher in the following summer. The half-bred ewe is again crossed with the Border Leicester ram, producing 'three-parts-bred' lambs, which are either sold fat as lambs, or are fed off on turnips and disposed of any time from December to March, according as they have been pushed forward more or less rapidly It should be added that within the last decade there has been a growing tendency to cross the half-bred ewe with a Down ram. For this purpose Oxfords, Shropshires, and Suffolks are used, with a decided preference for the Oxford. As to the relative merits of the Border Leicester and Down crosses opinions differ, and however strong the inclination may be, there is no intention of arguing the case here. Suffice it to say that the great majority of farmers are agreed, presumably as a result of experience and not of theorizing, that it is advisable to use the Border Leicester ram for at least the first, and in many cases also the second, crop of lambs, and to mate only the older ewes with the Down ram. The reason given for this is that the produce of the latter cross entails more difficulties at the time of parturition, and therefore there would be a risk of increased losses if the young ewes were mated with a Down ram. Of the half-bred ewes it only remains to be recorded that they are excellent nurses and very prolific breeders, for with ordinary care in management they will generally rear 175 per cent of lambs.

Another cross from the Border Leicester ram, second only in importance to the half-bred, is that from the Blackfaced ewe, known as the greyfaced or mule. These are bred more commonly in the north of England, especially in Northumberland, than in the south of Scotland, while they are also bred in very large numbers in the north of Scotland. They are not so large as the half-bred, but their mutton is perhaps of better quality. The ewes are managed in much the same way as the half-bred ewes, and like the latter they are good nurses, although not so prolific.

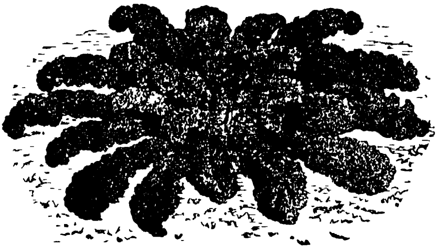
Having seen the extent to which the Border Leicester ram is utilized for crossing with the ewes of other breeds, it may be well to indicate briefly the reasons that make him so much valued for this purpose. Firstly, being a thick-fleshed and easily fattened sheep, when crossed with the thin-fleshed and slow-feeding mountain ewes the produce is a quickly maturing sheep, with a better quality of mutton than the sire and a greater quantity of it than the dam. This dual improvement is so marked that such crosses are regarded as the great rent-paying, commercial sheep in all the feeding districts of Scotland and the north of England. Secondly, being active, high spirited, and of a sound constitution, he is able to follow the ewes on the steep, exposed hillsides on which so many large flocks are pastured during the early winter months. The fact that for upwards of a century Border Leicester rams have stood this severe test is ample proof of their pluck and endurance. Thirdly, although he has a heavy carcass of mutton, he carries it on fine bones, and hence when he is crossed with small mountain ewes there is no great risk of loss during the lambing season, such as would be likely to result if strong boned, coarse-headed rams were used.

These characteristics justify the claim that is made on behalf of the Border Leicester, that of all British breeds of sheep he is the most valuable crossing sire in existence.

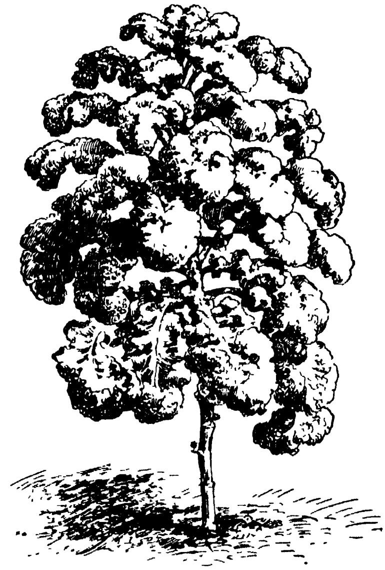
In 1898 the Border Leicester breeders formed themselves into a society 'The Society of Border Le[illegible] Sheep B[illegible]ede[illegible]r objects they had in view was that of issuing a Flock Book, in which not only both rams and ewes are registered, but each flock has its own registered number. The first volume of the Flock Book was issued in 1899, and showed that the Society consisted of 165 members, while 386 rams were registered under 160 flocks. Vol IX, issued in 1907, shows that the membership had been increased in the meantime to 251, and that the number of registered flocks is now 240. [J. Wo.]

[The writer desires to state that in the compilation of this article he has very largely relied upon the information contained in the many contributions made to the agricultural and other press by his late father, John Wood.]

Borecole.—The Borecoles or Kales form a section of the Cabbage tribe, and are among the hardiest and most useful, particularly for the supply of winter greens. They grow in any garden soil, and when well cultivated their leaves are excellent in flavour and really good wholesome food. Cottagers grow them largely, as they may be relied upon when few other vegetables can be got. The main crop should be sown in April, and when large enough to be transplanted they should be set out in rows in the usual way. The strongest growers may be planted 2 ft apart. In gardens where space is limited it is usual to plant Borecole between the rows of potatoes after the latter have been finally earthed up. When the potatoes are dug the Borecole should be earthed up. In dry weather it should be regularly watered. In gathering Borecole for consumption, the tops should be cut off first, the lateral growths then develop, and these may be taken in succession as they become large enough. Well-grown Borecole, if the shoots are gathered when they are young and tender, form a really excellent dish. The following are first-rate varieties:—



Borecole—Dwarf Green Curled



Tall Scotch Kale

ASPARAGUS or *Manchester Kale*.—Stems 2 ft. high, the leaves purplish; a favourite market variety, particularly in the north of England

COTTAGER'S KALE. — Stem 2 ft. high, with plain or curled leaves, green; an abundant sprouter, growing in the coldest weather.

EGYPTIAN KALE.—Stem 6 in. high, developing numerous succulent shoots in spring, which may be blanched and used as a substitute for Sea Kale.

PURPLE WINTER.—Very popular in Germany, and one of the most productive and hardy, its leaves are much curled, and of a deep-purple colour.

SCOTCH KALE.—Grows sometimes a yard high, and is an excellent spring vegetable, the flavour being much heightened by frost

TREE CABBAGE or *Jersey Kale* grows to the height of 6 ft., in Jersey even higher, its stems being sometimes used as walking-sticks It has large, oblong, wavy leaves, the young sprouts only being eaten. The *Thousand-headed Cabbage* is a form of this which does not grow so tall, and sprouts more freely

VARIEGATED KALE has much curled foliage, beautifully variegated, green, yellowish-white, green and purple, red, and purple varieties being known. It is used for garnishing, and is also excellent when cooked [W. W.]

Boric Acid and **Borates.**—Of all the modern chemical preservatives the boron preservatives, boric acid and borax, are the most largely used. Probably the only preservative which is more largely used is common salt There is this difference between the use of common salt and boric acid Salt is a necessary constituent of the body and of the food of animals, and therefore it is sometimes spoken of as a natural preservative The boron compounds, on the other hand, are not normal constituents of the food of animals, and do not play any part in the nutrition of the body or in building it up Salt has been used as a preservative of foods from time immemorial, while the boron compounds have come into use only in quite recent times At the same time it is to be remembered that foods preserved with salt contain excessive amounts of that constituent An animal fed largely on such foods receives amounts of salt far in excess of what are required for the functions of the body.

The boron compounds in use as preservatives are boric acid and borax. Borax is a sodium salt of boric acid. In other words it is a compound of soda and boric acid. Many preservatives sold under such fancy names as Arcticanus, Conservare, Glacialine, &c., are mixtures of these two substances. Others contain such substances as salt, nitre, salicylic acid, and carbonate of soda in addition to the boron compounds Generally speaking, however, the substances sold as food and milk preservatives are largely composed of boric acid and borax.

Boron compounds are found widely distributed in nature, but only in small quantities. They are found in minute quantities in many vegetable substances. They are found, for instance, in grapes and other fruits Preparations of fruits, therefore, such as wines, fruit juices, and preserves, may naturally contain a little boric acid. But the quantity so found is extremely small, and of quite a different order of magnitude from the quantities added artificially for preservative purposes. There is therefore no danger of mistaking the comparatively large quantities added as preservatives for the minute quantities which occur naturally. The commercial supply of boron compounds is obtained chiefly from volcanic regions, such as Tuscany. It is found in the waters of springs, in lakes, and in deposits formed by the drying up of lakes. It is obtained both as borax and as boric acid

Boron preservatives have largely replaced salt in the preservation of butter and of certain meat foods like bacon and ham With improved methods of preparing and preserving food, it is no longer necessary to use large amounts of common salt such as were formerly necessary In order to preserve butter for winter use it was formerly common to add 5 to 10 per cent of salt It was necessary to make the butter intensely salt if the salt was to be effective as a preservative. So in the case of ham and pork, when preserved with salt a large percentage of the preservative had to be used, and the foods were rendered unpalatably salt. Very salt foods are now almost unsaleable Public taste demands, for instance, that salt butter should be mild cured, that is, that it should not contain more than about 2 per cent of salt The same is the case with ham and bacon. Boric acid is almost without taste, and its preservative action is much more powerful than that of salt For instance, it has been found that 0·5 per cent of boric acid is sufficient to preserve butter, while 5 per cent of salt is required

According to the evidence given before the Departmental Committee on the Use of Preservatives in Food, boron preservatives have been found in milk, cream, condensed milk, sausages, potted meats, butter, margarine, bacon, ham, wines, temperance beverages, potted shrimps, caviare, fish (fresh and smoked), wines, ales, fruit juices, vinegar, game, poultry, tongues, meat extracts, fresh and salted meat, and feeding-cakes for cattle.

Boric acid and borax have little power of killing germs They do not act as preservatives by killing the germs which cause decay, but only by inhibiting or retarding their action. Thus, in the case of milk, the addition of boric acid in the quantities in which it is ordinarily used as a preservative merely delays the souring of the milk for a period, which varies with the temperature and the extent to which the milk has been contaminated with organisms. In no case will the preservative cause the milk to remain sweet more than two or three days longer than it would have done without any addition. The quantity of boric acid commonly added to milk varies from ·05 to ·1 per cent, or from 35 to 70 grains per gallon.

Fierce controversy has raged round the question whether the use of boron compounds as food preservatives should be prohibited or not. Both in this and in other countries this question has given rise to a great deal of enquiry and investigation The boron preservatives are now so extensively used, and in such a great variety of foods, that it becomes a question of importance to determine whether their unrestricted use endangers to any extent the public health, or is undesirable for any other reasons. On the one hand it is contended that boron compounds are harmless when taken in preservative quantities; that in the amounts used for preservation of foods they have even less effect on human beings than salt and nitre, which have been used as preservatives from time immemorial, that they are practically without taste and smell, and that therefore they are well suited for use as preservatives, and enable manufacturers to meet the modern demand for mild-cured articles. In connection with these contentions many experiments have been made on animals and human beings to show that the regular consumption of small quantities of boric acid does not injure them.

On the other hand it is contended that, unlike salt, boric acid is not a natural constituent of food or of the human body, that it has only been introduced as a preservative during quite recent times; that even if it does not do demonstrable harm where a few doses are taken, the continued consumption of even small quantities in foods will ultimately cause injury, if not to healthy adults at any rate to young persons, invalids, and those who suffer from weaknesses of certain kinds, and finally that the unrestricted use of such a convenient drug leads to carelessness in handling food, and to neglect of cleanliness and other precautions which are necessary to make it keep properly without chemical preservatives. Numerous experiments have been made in this and other countries on human beings and animals, showing that boric acid not only causes injury to the young and to those suffering from certain complaints, but even to healthy adults when it is taken for long-continued periods.

The result of the discussions and investigations which have taken place has been that the use of boric-acid preservatives has been prohibited in some countries and restricted in others. In this country the Departmental Committee on Food Preservatives, which reported in 1901, recommended that the use of boron and all other preservatives in the case of milk should be constituted an offence under the Sale of Food and Drugs Acts. They also recommended that it should be lawful to use boric acid as a preservative in cream, provided the amount does not exceed 0·25 per cent and is notified by a label upon the vessel; and that it should be lawful to use boric acid in butter so long as the amount does not exceed 0·5 per cent. With regard to ham and other foods, the Committee made no definite recommendation. The recommendations of the Committee have not yet been embodied in any Act of Parliament, but they are very generally acted upon by the authorities which administer the Food and Drugs Acts and by the Courts.

In addition to the use of boron preservatives in human foods, they are used to a certain extent in cattle foods. Their chief occurrence under this category is in Bombay cotton cake, which nearly always contains a little borax. It is said that this is not used so much as a preservative as because its presence gives the cake a brighter, fresher, and more attractive appearance.

Boron compounds are also used in medicine and surgery. Many antiseptic ointments and dressings for cuts, burns, &c., contain boric acid.

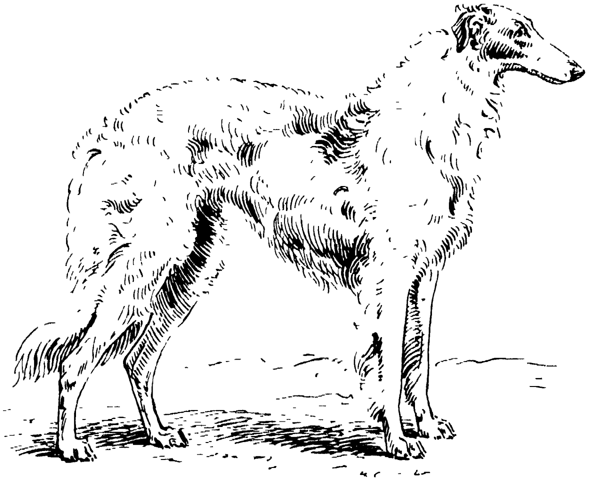
[J. H.]

Boring, the process of perforating wood, iron, rocks, or other hard substances by means of instruments adapted for the purpose. For boring wood the tools used are *awls*, *gimlets*, *augers*, and *bits* of various kinds, the latter being applied by means of a crank-shaped instrument called a *brace*, or else by a lathe, transverse handle, or drilling machine. Boring in metal is done by *drills* or *boring bars* revolved by boring machines. Boring in the earth or rock for mining, geologic, or engineering purposes is effected by means of augers, drills, or jumpers, sometimes wrought by hand, but now usually by machinery driven by steam or frequently by compressed air. In ordinary mining practice a bore hole is usually commenced by digging a small pit about 6 ft. deep, over which is set up a shear-legs with pulley, &c. The boring rods are from 10 to 20 ft. in length, capable of being jointed together by box and screw, and having a chisel inserted at the lower end. A lever is employed to raise the bore rods, to which a slight twisting motion is given at each stroke, when the rock at the bottom of the hole is broken by the repeated percussion of the cutting-tool. Various methods are employed to clear out the triturated rock. The work is much quickened by the substitution of steam power, water power, or even horse power for manual labour. Of the many forms of boring machines now in use may be mentioned the diamond boring machine, invented by Leschot, a Swiss engineer. In this the cutting-tool is of a tubular form, and receives a uniform rotatory motion, the result being the production of a cylindrical core from the rock of the same size as the inner periphery of the tube. The boring bit is a steel thimble, about 4 in. in length, having two rows of Brazilian black diamonds firmly embedded therein, the edges projecting slightly. The diamond teeth are the only parts which come in contact with the rock, and their hardness is such that an enormous length can be bored with but little appreciable wear.

Borzoi Hound.—The Borzoi, under the name of the Russian wolfhound, has been known in this country for nearly thirty years, the frequenters of dog shows having become familiarized with it through Lady Emily Peel's Sandringham, a dog which won many prizes in his day. It was not, however, until a very much more recent period that the popularity of the breed became established in England, where it is now a favourite breed amongst the aristocracy, Her Majesty Queen Alexandra possessing one of the most successful show kennels in the country.

In its native country—Russia—the lines of the Borzoi have always fallen in very pleasant places, as from time immemorial the breed has been identified with the reigning house, the kennels of the Grand Dukes being filled by admirable specimens of the variety, possessed of lengthy and well-authenticated pedigrees. Of recent years many of these illustrious personages have permitted specimens of their breeds to be exported to England and elsewhere, the result being that amongst the kennels in this country there are several whose inmates are fully equal to competing against the best Borzois that Russia could bring against them.

At the same time it must not be imagined that the Borzoi is bred in Russia, either by members of the Royal family or by humbler individuals, merely as a companionable or ornamental dog. The reverse is the fact, as the breed enters largely into the existent conditions of sport, being used largely by wolf-hunters in their operations. The duties of these hounds when so engaged resemble in a great measure those of the Scottish deerhound in our northern forests, as they are required to follow and hold up a wounded wolf until the hunters arrive and inflict the *coup de grâce.* By many people it is imagined that the hounds are sent into the coverts to engage the enemy, but this is not the case, the usual course being for them to be held in reserve outside a wood, and to be slipped at wounded wolves as they escape to the open.



Borzoi Hound

It is perhaps fortunate that more is not expected of the Borzois, for they are by no means brainy dogs; in fact, beautiful though they are, their intelligence is lower than that of the average member of the canine race, and this is not surprising when the extreme narrowness of the skulls is remembered. Hence the experiments, which undoubtedly have been made, of crossing them with the collie have proved disastrous to the intelligence of the descendants of the cross, undoubtedly handsome though some of them are.

The general appearance of the Borzoi resembles that of both the deerhound and the greyhound, but as a rule he is a much taller animal than either of them, though upon more elegant lines. His head, too, is far longer and narrower, and his coat, which is long and silky, though at the same time weather-resisting, provides another feature of distinction. The skull is not merely narrow, but curiously curved; in fact, in some dogs it is shaped from the tip of the nose to the occipital protuberance something like a bow. The muzzle is long and the jaws and teeth extremely powerful, whilst the eyes, though small, not infrequently possess the peculiar languishing expression which is so characteristic of the collie.

The neck of the Borzoi is long and gracefully arched, the shoulders oblique, and the chest, like that of the greyhound, very deep and narrow, so that there is plenty of space provided for the heart and lungs without impairing the speed of the dog, as the broad-chested breeds are invariably slow by comparison with the others. The body is long and flat sided, there being a decided rise at the loins, which are powerful, whilst the tail is carried rather low. The tail itself is profusely feathered with long silken hair and is scimitar-shaped, though if the animal is excited it is carried a little higher than usual. The front legs are rather long, but must be heavy in bone and set on well under the dog, for a Borzoi which is out at shoulder or bent in his fore legs possesses very great faults.

The coat, as mentioned above, is silky in appearance and of a good length, but it is not so fine to the touch as might be imagined, and there is a sufficiency of under coat to assist the outer one in keeping the skin of the dog both dry and warm, even when he is exposed to the influences of bad weather. The narrowness of his chest, the length of his legs, and the manner in which the hind ones are bent, all combine to render the Borzoi a very speedy dog, as indeed he needs to be, as a wolf that is only superficially wounded would soon leave a slow dog far behind him when he bolts for safety. The Borzoi, moreover, in spite of his refined appearance and the soft, languishing expression of his eyes, is unquestionably a very courageous dog, and one that will give and receive punishment far better than could possibly be imagined from his looks. As observed above, he is not a particularly intelligent animal, and hence his value as a companion is inferior to that of many other breeds, but in the manner of good looks he suffers by comparison with no other variety. Indeed there can be few more attractive sights for the dog lover than three or four couples of highly bred Borzois disporting themselves in a meadow, their white coats relieved by fawn or brindle markings flashing in the sunlight, whilst the grace and elegance of their movements would alone be sufficient to attract the attention of all who see them. The weight of a full-grown Borzoi is about 100 lb., bitches averaging about 25 lb. less There is a club devoted to the interests of the breed, and to the members of this association much of its improvement is undoubtedly due [V. S.]

Bos antiquus, longifrons, &c See CATTLE.

Bostrichus. See XYLOBORUS

Botany. — The science of botany is concerned with the study of plants, and since these may be viewed or studied from many different standpoints, several different divisions of the subject arise

The form of the plant and its several parts may be the object of the study, this branch of botany being spoken of as *morphology* It is concerned with the form and development of the roots, stems, leaves, and other members of the body of the plant, and also with their structure or anatomy, as well as with the nature and form of the cells and tissues of which the parts are constructed

The study of *physiology*, another branch of the science, deals with the functions or work carried on by the various parts of the plant The great problems of the absorption of food materials by growing plants, the processes of respiration, transpiration, assimilation, and reproduction, are the main objects of physiological study Most of these are treated in special articles, and are of the utmost importance to the farmer or gardener who wishes to thoroughly grasp the meaning of sound practice in the management of crops of all kinds (See, in particular, art PLANTS, GROWTH OF)

The third great division, that of *taxonomy* or the *classification of plants*, may be more especially dealt with here Systematic or classificatory botany is concerned with the nomenclature and description of plants, and their arrangement into groups. Two main principles of classification are possible In some systems the various forms of plants are arranged according to an arbitrary standard of habit, shape, or number of parts of the flowers or other organs Of these *artificial* systems of classification the best known is that adopted by Linnæus In this scheme flowering plants are placed in groups according to the number and arrangement of the stamens and carpels of the flowers

The *natural* system of classification now in general use endeavours to place all representatives of the vegetable kingdom in the order of their genetic relationship, it being assumed that all living things are related to each other by descent A complete and exact determination of the evolutionary history and the construction of a family tree of the plant world is, however, not likely to be attained, since many links in the chain of development have disappeared No hard-and-fast rules can be laid down for determining genetic affinity among plants, but in forming the groups of the natural system botanists take into consideration many characters of the plants — their general structure, the morphology of the reproductive organs, as well as the facts of their life-history, and the geological record as far as it can be ascertained. In this way it is contended that those plants most nearly related by descent will be placed together.

Special names are given to the different groups into which plants are divided. All individual plants which resemble each other in form and structure of root, stem, leaves, flowers, and other characters, so much that they may be considered to be descended from a common ancestor, are spoken of as a *species*

Variations occur within the species group, and it is found necessary to have terms for these To the fluctuating variations which are common among the descendants of living things there is little need to refer further they are not transmitted to the offspring. Variations, however, of a permanent nature often arise, and appear with regularity in the subsequent generations; such are sometimes named *sports* and *mutations* Plants exhibiting these constant variations from the type species are named *sub-species* Among wheat, barley, cabbage, and other cultivated plants, groups of this character are common, and are usually spoken of as *races*

Certain species closely resemble each other in many characters, and are united into a group called a *genus*. Thus the cabbage, turnip, charlock, and mustard resemble each other in general form and structure of their floral organs, they form the genus Brassica

The botanical name of a plant consists of two Latin words, the first indicating the genus, the second the species to which it belongs. Thus the cabbage is named *Brassica oleracea*, the turnip *Brassica Rapa* Since the same species has been sometimes named differently by two botanists, it is usual to append to the name that of the botanist who used it (his name being generally in an abbreviated form) *B oleracea*, Linn, or *B oleracea*, L, means that Linnæus gave this name, and the plant meant is that which he described under this name

Genera are grouped together into *families* or *orders*, orders into *classes*, and classes into *divisions* Every individual plant, therefore, belongs to a species, every species to a genus, every genus to a family or order, and so on.

The following are generally recognized divisions and classes of the vegetable kingdom:—

Sometimes termed Cryptogams or Flowerless Plants	Division	I Thallophyta—
		Class 1 Algæ.
		Class 2 Fungi
	Archegoniatæ	II. Bryophyta—
		Class 3. Hepaticæ
		Class 4. Musci.
		III Pteridophyta—
		Class 5 Filicineæ
		Class 6 Equisetineæ
		Class 7. Lycopodineæ
Phanerogams or Flowering Plants	Division	IV. Spermatophyta
		Subdivision A Gymnospermæ.
		Class 8. Gymnospermæ.
		Subdivision B Angiospermæ
		Class 9 Monocotyledones
		Class 10 Dicotyledones.

The Thallophyta are simple plants which exhibit little or no differentiation of the body into stem, root, or leaves, the branches when they occur being like the rest of the body of the plant. Of these the Algæ possess chlorophyll, the Fungi none. The latter are of great economic importance, since among them are mushrooms, toadstools, and moulds, many of which are the cause of diseases in higher plants.

In nature two or three groups of organisms are met with which are of very simple construction, and exhibit affinities both with the animal and vegetable kingdoms. Among them are (1) the Myxomycetes or Mycetozoa, which in the vegetative state are naked, slimy pieces of protoplasm capable of creeping about on rotten wood, leaves, and other materials; (2) the Flagellatæ, unicellular motile organisms met with in water, some of them having chlorophyll within them and a mouth for the ingestion of food; and (3) the Schizophyta, to which belong the Schizomycetes or bacteria. The exact nature and affinity of these organisms is not known, when they are claimed for the vegetable kingdom they are classed among the Thallophyta, or placed in sub-kingdoms or divisions of their own.

The second division as given in the above table, the Bryophyta, includes mosses and the allied liverworts, while to the third division, the Pteridophyta, belong ferns, clubmosses, and horsetails. The latter are commonly seen in ditches and damp places, some species are troublesome weeds on stiff arable land. These two divisions are sometimes combined and designated Archegoniatæ, on account of the character and close resemblance of their reproductive organs. The female reproductive organ, or *archegonium*, is a flask-shaped body containing the ovum, which is fertilized by motile spermatozoids produced by the male organ or antheridium.

Among these plants (the Archegoniatæ) two well-marked forms are assumed in the course of their life-history: one of the forms, the *gametophyte*, producing gametes or sexual spores, which unite and give rise to a fertilized ovum capable of growth into a new plant, the other, the *sporophyte*, bears asexually produced spores, which give rise under suitable conditions to new plants also. In the life-cycle there is usually an alternation of generations, the gametophyte being succeeded by the sporophyte, the two forms are generally quite distinct in size and morphological character. A fern, for example, *i.e.* a plant which we know as a fern, and to which a specific name is given, belongs to the sporophyte generation. It is a large leafy plant on which asexually produced spores originate. These spores on germination give rise to a small green flat plant, the gametophyte (also termed the *prothallium*), on which are produced the sexual organs and the gametes. The latter, after union in the act of fertilization, give rise to a new sporophyte or fern plant.

In the mosses the relative size is reversed, the gametophyte being the leafy plant to which the specific name is given, the sporophyte being the elongated stalk and capsule, popularly known as the 'fruit' of the moss plant.

The division of the Spermatophyta or seed-bearing plants far outweighs all other groups both in point of number of species and in importance. In it are included the majority of plants which are cultivated and utilized by man, or used as food by animals. The chief feature of the division is the production of a 'seed', a peculiar structure which when ripe contains within it an embryo or young plant.

The plants belonging to this division seem to be the descendants of some of the Archegoniatæ, and like them possess reproductive organs, which, although much modified, suggest relationship with the former. Moreover, an alternation of generations is present in their cycle of development. The highly developed structure known and described as the plant itself in this division is the sporophyte or asexual generation, as in the case of the ferns. The gametophytes are very reduced, existing only as a few cells in the pollen-grain and ovule, and never visible as separate organisms free from the sporophyte. The male sexual cells are present in the pollen-grains produced by the stamens, the female cells arising in the ovules borne by the carpels of the flowers. After fertilization the ovule becomes the seed, the ovum developing within it into an embryo, the new sporophyte—which for a time remains attached to the old sporophyte.

In the subdivision Gymnosperms the ovules are exposed on open flattened carpels, while in the Angiosperms the ovules are enclosed in a hollow ovary formed by the cohesion of the edges of the carpels.

Included in the Gymnosperms is the order Coniferæ, which is divided into two sub-orders—(1) the Taxaceæ—the yews, and (2) the Pinaceæ, which embraces many of the largest forest trees, the firs, pines, larches, and cedars, whose timber is so much used. A large number of conifers are also grown in parks and gardens for ornamental purposes.

The Angiosperms are divided into two great classes—the Monocotyledons and Dicotyledons; the former possessing embryos each with a single cotyledon or seed-leaf, the embryos of the latter having two opposite seed-leaves. In the Monocotyledons the leaves are often simple, linear or lanceolate, generally with parallel veining. The flowers formed of whorls of three modified leaves.

Although less numerous than the Dicotyledons, the Monocotyledons are very commonly distributed. In the Tropics is the family of the palms, many of which, such as the date and cocos palms, are large and important trees. From *Elæis guineensis* palm oil is obtained; species of Raphia yield so-called Raffia bast from their leaves. The Cyperaceæ or sedges, and Juncaceæ or rushes, are large families, many species of which are well known in ponds, ditches, and damp meadows. Included also in this division are the Orchidaceæ or orchids, the Liliaceæ, to which belong lilies, crocuses, tulips, hyacinths, fritillaries, and yuccas, the Iridaceæ or irises; the Amaryllidaceæ, which embraces the narcissi and many other families whose representatives are grown for ornament in gardens and greenhouses.

The most important order, however, among Monocotyledons is the Gramineæ, embracing about 3500 species. To it belong the grasses, which form such a conspicuous part of the world's vegetation, covering the ground in temperate regions, and from which the food-grains wheat, barley, oats, rye, rice, and maize are obtained for the needs of man and farm stock, besides the sugar-cane and the bamboo.

In typical Dicotyledons the embryo has two cotyledons, often fleshy, a rootlet, and a terminal bud. The vascular bundles in the stem are usually arranged in a circle; in the perennial woody stems there is developed a cambium ring which is responsible for their growth in thickness. A typical leaf is usually broad, stalked, and has reticulate veins. The flowers have whorls of modified leaves in fours or fives, or multiples of these numbers. There is great diversity of form and structure among Dicotyledons, and their classification is still unsettled in many particulars. Two or three sub-classes may be recognized, namely (1) the Apetalæ, (2) the Choripetalæ; and (3) the Sympetalæ.

The Apetalæ include a number of orders, the flowers of which are often of very simple structure, either without petals or with a small perianth of scaly leaves; many of them are diclinous. To this group belong the Salicaceæ—the family of willows and poplars, the Betulaceæ—birches, alders, and hazels, the Fagaceæ, which includes the beech and oaks, and the Ulmaceæ—the elms, as well as other well-known timber trees. The hop, hemp, stinging nettle, docks, and buckwheat are plants belonging to this subdivision of the Dicotyledons.

The Choripetalæ generally have bisexual flowers with a separate calyx and corolla, the latter consisting of free petals. In this group are many important orders or families, some of the most commonly occurring examples may be mentioned. The Caryophyllaceæ or pink family includes chickweeds, spurrey, campion—well-known weeds, and Gypsophila, carnations and pinks of gardens. The Ranunculaceæ or crowfoot family includes crowfoots and many ornamental garden plants such as delphiniums, aquilegias, pæonies, and species of clematis.

The very important family the Cruciferæ, which embraces the turnip, cabbage, radish, mustard, as well as the watercress and wallflower, belongs to the subdivision. Also the Rosaceæ, to which belong the fruit-trees apples, pears, plums, and cherries, in addition to strawberries, and the great variety of roses.

Another important family of Choripetalæ is the Leguminosæ or pea family, comprising clovers, vetches, beans, peas, and sainfoin, so valuable to the farmer, as well as many decorative garden plants, such as lupin, cytisus, and mimosa. The Umbelliferæ, a large, well-defined family or order, may be noted here also. To it belong celery, carrot, parsnip, fennel, caraway, and the poisonous hemlock.

The Sympetalæ are characterized by calyx and corolla, the latter being gamopetalous, having its petals united. This is perhaps the most highly specialized group of the vegetable kingdom. It comprises comparatively few families, but the number of species in each family is often very large.

The following orders are important:—The Ericaceæ or heaths; the Primulaceæ, a large family of plants, usually with attractive flowers; the Gentianaceæ or gentians, with their sky-blue flowers; the Labiatæ, to which belong mints, rosemary, sage, thyme, and deadnettles; the Solanaceæ, including the tomato, potato, henbane, capsicum, tobacco, petunia, and salpiglossis; the Scrophulariaceæ, which embraces the snapdragon, foxglove, and calceolaria; and the Cucurbitaceæ or cucumber and melon family.

To the Sympetalæ belongs also the Compositæ or daisy family, which represents the most advanced type of plant, and forms a family containing the greatest number of species, about 12,000 being already described. Comparatively few are cultivated for food of man or fodder for animals, except artichoke, sunflower, lettuce, and chicory. Some of them, *e.g.* groundsel, thistles, dandelion, coltsfoot, are objectionable pests on arable land and in pasture. Many species, such as the asters, dahlias, and chrysanthemums, are grown in gardens for their beautiful flowers. See arts. CONIFERÆ, COMPOSITÆ, ROSACEÆ, &c., also ASSIMILATION OF PLANTS, ACCLIMATIZATION OF PLANTS, REPRODUCTION, FERTILIZATION. [J. P.]

Bothy System.—This is the name given to a system of housing unmarried male farm servants, which still is and has been for a good many years prevalent in many parts of Scotland. Especially is it common on the large arable farms in the midland and northern parts of the country. Many of these large farms require for their proper staffing the employment of, it may be four, five, six, or even more unmarried men in addition to the married hands. As the cottage accommodation on such farms is usually quite inadequate for such a number, the unmarried men are accommodated in what is called a 'bothy'. This is usually a large single-apartment building standing by itself or abutting on to the steading, with bed cubicles around for the occupants to sleep in. Occasionally, however, the bothy is simply a detached cottage, which has been made into two apartments—one for cooking and eating, and the other for sleeping in. Not so long ago it was the custom to provide the bothy men with sleeping accommodation over the stables or in some similar convenient place, but since the requirements of the sanitary authorities became more exacting, it has been found necessary to do away with much of this class of bedroom accommodation and provide something better. Even yet it cannot be said that the sleeping accommodation provided on most farms for the bothy men is luxurious, although as a rule it is quite healthy and comfortable.

Men living in the farm bothy usually provide entirely for themselves—that is, they do the whole of their own cooking, washing up, and the like. Practically the only assistance in housekeeping which they receive is that a woman—usually the wife of one of the married servants—is paid by the farmer to wash out the bothy twice a week, and make the men's beds while they are at work. Occasionally this woman will also bake for the men, but this, when it is done, is largely a matter of private arrangement between the parties, and outside of the terms agreed upon with the master. In some cases it is not even customary to provide a woman for any purpose in connection with the bothy, although the number of such cases is getting fewer every year, and will rightly continue to decrease. Men living in the bothy get in addition to a stated wage, free fire and light, and an allowance of milk and meal. The latter is to a large extent an essential principle of the bothy system, and varies to some extent with the district. In the north, for example, the diet of the average farm servant still consists very largely of oatmeal and milk. In this part of the country a fairly large allowance of both is made. In the midland and southern districts, on the other hand, there has been a tendency of late years to vary the diet more, and here the servant very often takes part of his meal in the form of either cash or potatoes, and buys extras from grocery carts and the like.

A few cases of actual allowances of this kind will illustrate what the system means. A home farm in Morayshire may be taken as fairly representative of the custom in the north. Here the men living in the bothy get 6½ bolls of meal per annum, with 3 pints of sweet milk per day, a pint being given at each of three milkings. They get a woman to clean the bothy and cook their food. In addition to that they are allowed practically what potatoes they like, and in summer have a kitchen garden, from which they are free to take what vegetables they choose. Should the allowance of oatmeal not all be required the surplus is paid for by the employer at market price, and the sum handed to the servant at term settlements. Good men living under these conditions get in addition from £36 to £38 per annum of money wages, the last-named figure being quite as common as the first. On another northern farm, this time in Inverness-shire, the allowance of meal and milk is exactly the same, but in this case potatoes are only allowed two days a week. A woman is, however, provided to put on the bothy fire in the morning and boil the kettle, while she also has the kettle boiling when the men come in for the midday meal. The bothy system is very largely in use in Forfarshire and adjoining counties. In Forfarshire of late years the quantity of meal given has been very much reduced, mainly at the instigation of the men themselves, as they found they had always too much. Now the custom is something like the following: meal, 3½ bolls in the year; milk, 12 gills in winter, and 16 to 18 gills in summer, both per day. In most cases a woman is provided to clean out the bothy and have a fire on for meal times, but at several farms the men do the whole thing for themselves.

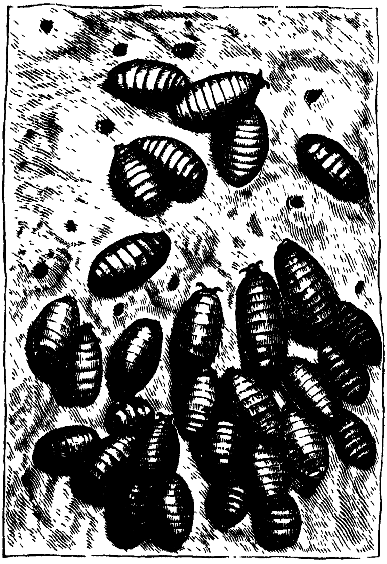
In such cases where the meal allowance has been cut down, the wages paid are proportionately higher, the prevailing rate in Forfarshire being up to £21 per half-year for first-class men, as against up to £19 in the north. On a farm in Stirlingshire the same quantities of meal and milk as in the north, viz. 6½ bolls of the former per year and 3 pints per day of milk, are allowed, but in this case a woman is provided only on Saturday to clean out the bothy, and there is no stipulation to give either potatoes or vegetables, although as a matter of fact such are frequently given. In all cases it is customary to allow money for meal not used, as also to give a money equivalent when the milk supply for any reason falls short. While the servants take the money readily enough for meal, they always prefer to get milk to cash, it being difficult frequently in country districts to get milk conveniently. The bothy servant has this additional handicap that he has not anyone as a rule to send for it. In many cases, both north and south, it is customary to give the married servants the same allowances of meal and milk as the bothy men. The married men have also frequently an arrangement for a load of potatoes, and straw to bed a pig.

Work in the bothy is usually done by rotation amongst the servants. Thus in the morning, while the other servants go to the stable to feed the horses, one is left to see to the fire and make the porridge or brose, as the case may be. The latter, it may be explained for the benefit of those who do not know what brose is, is a compound of oatmeal, salt, pepper (if thought necessary), and hot water. The water is poured on to the mass boiling, and the meal rapidly stirred to ensure saturation all through. The mass, after being allowed to cool, which it rapidly does, is eaten either with milk poured over it, or with milk served in another basin. Should it be desired to make the dish specially tasty, a lump of fresh butter can be put amongst the meal before the hot water is poured on. Only those who have breakfasted off brose can realize how appetizing and sustaining it is when properly made. Unfortunately many farm servants have deserted the humble but substantial fare of their fathers, and now the teapot and the saucepan is as much in evidence in many bothies as the old-fashioned wide-mouthed brose basin used to be.

Whatever may be said against the bothy system from a social or moral point of view—and few would care to defend it in either respect—there is no doubt that it has its compensating advantages. In no other way would it be possible for young men engaged in farm labour to live so cheaply. So long as they are content with the natural food products which come their way as part of the price of their labour they have practically no expenditure, except it be a few pounds in the course of the year for clothing. Thrifty young ploughmen living in bothies have been known to save as much as £20 a year as a regular thing, and occasionally more. But these were the kind who stayed at home and did not run here and there by nights or on holidays. In this connection it may be said that the introduction of the all-prevailing 'bike', and the cut that there has been in the prices of such, has been of doubtful advantage to the farm-servant class. Once in possession of a bicycle there is a great inducement to be always on the road in spare time, and opportunities for spending both money and time are thus met with that would never have been encountered otherwise.

A peculiar feature in connection with the bothy system is that while it is all but general over the midland and northern districts of Scotland, it is practically unknown in the Lothians —Mid and East Lothian particularly. There the system followed is what is known as single and double hinding—in other words the workers hire themselves in twos and threes, and frequently in families. They all live in cottages together, the sons and daughters very frequently residing in their fathers' houses until they get married and set up in houses for themselves. It is not very easy to say what is the exact cause of this difference of method in circumstances which between south and north are not greatly dissimilar. No doubt a more liberal supply of cottages at most Lothian farms has a good deal to do with it, inducing as it does the workers to stay longer in one place. But whatever may be the cause, one cannot help feeling that from most points of view the Lothian cottage system has the advantage over the northern bothy system. [A. S. G.]

Bots.—Bots, recognized as grubs or maggots, are very common among horses, and have their analogue in the ox and the sheep. The Horse Bot Fly (*Œstrus equi*) deposits its yellow-coloured eggs upon those parts of the horse most easily licked off, and thus gains admission to the stomach, where it fastens on the lining membrane, and remains from July or August until the following summer, when it passes out with the fæces, becomes a chrysalis, and presently hatches into a fly, thus completing the cycle of life. Unless a large number of bots collect in the stomach they are usually said to do no harm, but cases have occurred where the wall has given way, owing to their numbers, or numerous punctures, and death has resulted.



Larvæ of Bot Fly anchored on to mucous membrane of the stomach of the horse

Treatment is of very little use, as the mouth of the grub is buried in the mucous membrane, and destroying agents pass by. Much credit is given to remedies administered at the time of year when bots voluntarily quit their winter quarters, but the substance has yet to be found that will expel them in midwinter. Bisulphide of carbon, in capsules, has the best reputation among the many remedies tried.

Another variety of bot infests the horse, and is known as the fundament bot from the fact that the fly deposits its eggs in the mucous folds of the rectum, when they are extruded in the act of defæcation, and there the bots become attached and remain until the following season. In this situation many can be picked off, and others destroyed by the introduction of mercurial ointment upon a finger. See also HYPODERMA and ŒSTRUS. [H. L.]

Bottled Milk. See MILK.

Bottom Heat.—By the application of a higher temperature to the roots of plants than that in which the stems and leaves are, active growth is quickly promoted. The best example is that of a hotbed such as is made for cucumbers, melons, &c. Beds made up of fermenting material, such as horse dung, tan, or a mixture of grass and dead leaves, are often employed by market gardeners. Of course the heat from the bed rises and affects the temperature of the air immediately above it, the moisture, and probably to some extent the gases, given off also have a beneficial effect upon growth. When applied on a large scale, hot-water pipes are used to supply bottom heat. Where the forcing of flowers or vegetables is practised, bottom heat is an important factor. [W. W.]

Boulder Clay. See DRIFT.

Boulonnais Horse.—There are two varieties of the Boulonnais breed, differing only in size. They are known respectively as the large and the small Boulonnais. The former is one of the chief draught breeds of France, and is extensively bred in the districts round Boulogne, Calais, Montreuil, and Saint Omer. The breeding of the small Boulonnais was formerly carried on for the purpose of supplying a light but very active horse for the transport of goods by canal before the introduction of railways. At the present day the aim is to breed out the small variety as far as possible. The large Boulonnais develops very rapidly, being broken to agricultural work when rising two. At four years of age he has attained his maximum size and weight, and at this age the best specimens are sold in Paris for van and lorry work.

The breed is characterized by its muscular development, while it is at the same time rapid in action. The body is short and thickset, and the back at an early age becomes slightly hollow; the chest and shoulders are specially well developed, and the ribs are also well sprung. The head is rather large, but well carried by the short, powerful neck. The legs are short and stout, and sparsely feathered. The feet are not large, but are sound, as a rule, and comparatively free from sidebones. There is no uniformity of colour in the Boulonnais, bay, roan, and dappled-grey being common. The last is preferred by Parisian buyers. The height varies from 16 to 17 hands. The Boulonnais is good-tempered and docile. A stud book was established for the breed by the Agricultural Syndicate of Boulogne in 1886

Boundary.—A boundary is the line of division which separates two adjacent properties. The line may be marked by objects natural or artificial, or may be merely imaginary Thus the boundary may be a river, a wall, or a line taken between two given points. If the boundaries are so ambiguously stated in the titles as to admit of two readings, then, if the area of the ground is also given, that reading is preferred which agrees with the area mentioned. If the boundaries conflict with a plan subscribed as relative to the description of the ground, then, if the measurement is also given, the boundaries or the plan will prevail according as one or other agrees with the measurement.

In England, where the boundary is some object, as a river, a ditch, a wall, or a tree, the centre of the object specified is the boundary limiting the grant But in Scotland, as a rule, when a property is bounded by some physical object, the object itself is not included in the property. Thus, where a property is said to be bounded by a wall, a canal, or a road, the wall and the ground it stands on, the canal and towing path, and the road are each respectively excluded. If, however, the road forms the division between two estates, then the presumption is that the centre of the road is the dividing line On the other hand, where a river is the boundary, the presumption in Scotland, as in England, is that a line drawn along the centre of the stream is the boundary.

Where a property is bounded by the 'sea', the 'sea shore', the 'sea beach', or by a tidal river, this in Scotland will be taken to mean the low-water mark of ordinary spring tides Where such expressions as the 'full sea', the 'sea flood', or 'flood mark' are used, this will mean high-water mark

Where part of the boundary is a ditch, or ditch and bank, either with or without a hedge, and the titles are not express, the Court must interpret the limits according to certain general principles Thus, where the boundary is a bank with a ditch beyond it, the presumption is that both bank and ditch belong to the property which lies over the bank from the ditch, since 'no man making a ditch can cut into his neighbour's soil, but usually goes to the very extremity of his own land He, of course, is bound to throw the soil which he digs out upon his own land, and then, if he likes, he plants a hedge on the top of it.' [D B.]

Bounties.—Bounties are financial methods of encouraging certain activities or activities in certain places. Thus scholarships, prizes for designs, subsidies on sea transportation and shipbuilding, and payments on the production of certain commodities, are all technically bounties Subsidies are sometimes distinguished from bounties, but it is impossible to draw any logical line between the two, though it is usual to speak of shipping subsidies and railway subsidies, but of corn bounties and sugar bounties. In this article no difference will be recognized between the two, and our attention will be confined to bounties which are intended to effect an economic end. Corn bounties, herring bounties, linen bounties, bounties on refined sugar, and bounties on shipping and railway transportation, have all been tried by the Government of this country, but the triumph of the free-trade movement has caused us to make less use of the subsidy of late than many other countries

Theoretically bounties may be regarded as negative taxes The argument against bounties on export, as compared with bounties on production, is that the benefit of the former falls mainly upon the foreign consumer. Indeed the home producer may actually suffer damage, in addition to that inflicted by the tax to provide the bounty, because the home price may be raised If production be subject to decreasing returns, this result would inevitably follow. Advocates of bounties on export have argued that numerous intangible benefits are secured by foreign trade, and that by their means industrial expansion is brought about much cheaper than it could be were the bounties paid on the whole of production. One case in which the bounty on export is preferable to protection to secure the same end is found when a country is anxious to encourage some industry in a colony which does not provide the mother country and cannot hope to do so economically—with all that the mother country requires of the product of such an industry. The mother country might impose a tariff on such goods when they originated elsewhere, but the cost to herself might be significantly less if she paid a bounty to her colony on her receipts of these colonial goods. In the past, when mercantilist doctrine was widely accepted, bounties on export were held wise, because by stimulating export they attracted bullion to the country But just as there are conceivable cases in which a country may gain at the expense of foreign countries by protection, apart from the hastening of industrial development, so there are conceivable cases in which it may profit from the same source by means of bounties Bounties on production are justified on much the same grounds as protection. They afford more encouragement than protection, because they not only ward off foreign competition, but stimulate the bounty fed industry at the expense of other industries, even those at home Conceivably by such bounties a country might profit, that is to say the gain from the bounties might exceed the sacrifices necessitated by the taxes whereby they were raised, even were the industry well established before it was subsidized. Such a result would be more likely if increasing returns applied to the bounty-fed industry This has been pointed out by Marshall in his Principles of Economics. We are disregarding, of course, any balance of satisfaction to the country which might accrue from any redistribution of wealth entailed by the character of the taxes. It is so difficult—indeed it is impossible—to gauge accurately where and for how long a gain could be made in this way, that it is doubtful policy to seek it. Bounties have usually been employed to stimulate home industrialism or agriculture, so as to hasten progress or prevent dependence upon other countries, or with a view to national power. Most bounties on shipping have had the navy in view. It is of interest to notice the case in which an activity worth subsidizing might never appear were it not for bounties, though it is merely a corollary from the theoretical justification of bounties on economic grounds in certain cases, which has been advanced above. If the cost of a service for every quantity provided exceeded the price which could be obtained, provision of the service could never pay, but as the benefit from a service must always be greater than the total amount paid for it by consumers (for some people must get it for less than they would give for it), it might pay the community to award as a bounty the difference between the cost of the service and the total takings. In this way the public building of bridges is justified and the subsidizing of much transport. As regards transport, service can sometimes be secured without a bounty if trade discriminations in rates be permitted. Sometimes the bounty is economically admissible as a temporary expedient to bring about the conditions which will ultimately render it unnecessary. Thus a railway in a country district may not be remunerative for years, but ultimately it may attract the population and industries from which freight yielding a handsome profit may be secured. Again, as regards subsidies to railways, the payment is sometimes allowed on military considerations, the line being laid where it is of military importance, but not in the best place for business. An examination of the subsidies paid on transportation (both railway and oversea) would reveal very mixed motives.

Perhaps the most famous bounties of recent times are the sugar bounties. These generally arose—at any rate the extravagant subsidies actually paid—out of unintentional miscalculation or intentional understatement of the saccharine yield of beets, or out of improvements in methods of extraction taking place while the old rate of yield continued to be assumed. They became most noticeable in France, Germany, and Austria. These countries imposed a heavy tax on imported sugar, and collected an excise not on home-manufactured sugar, but on the beets from which it was obtained. The tax became less than it was ostensibly reckoned to be, for the reason given, and as a drawback was paid on the same basis an enormous bounty operated on export. Thus suppose the basis taken to be 20 tons of beet for 1 ton of sugar, and suppose that 10 tons of beet at the same time yield 1 ton of sugar. Then the excise becomes half what it was intended to be, in view of the tariff on imported sugar. Moreover, when 1 ton of sugar was exported it was presumed that it represented 20 tons of beet, whereas it really represented only 10 tons. Hence an amount twice the tax paid on the beets would be obtained when the sugar was exported. It is not surprising that beet sugar drove cane sugar out of the European market. Space forbids that we should describe the various changes which took place in the fiscal details underlying these bounties. They began in Germany before the middle of the 19th century. France came deliberately into line with Germany in 1884. Towards the end of the 19th century there was a disposition in France, Germany, and Austria to escape from the burden. A convention on the subject was signed at Brussels on March 5, 1902. It came into force on September 1, 1903, and was to last for five years, thus continuing in force until August 31, 1908. The contracting States undertook. (1) Not to give bounties direct or indirect; (2) not to maintain a *surtaxe* in excess of 6 francs per 100 kilos for refined, or 5 francs 50 per 100 kilos for raw sugar [by *surtaxe* is meant the amount by which a customs duty exceeds the excise duty]; (3) to levy a countervailing duty on all bounty-fed sugar imported, or else to prohibit such importation altogether, (4) to take steps to prevent bounty-fed sugar, which might pass through their territory in transit, from enjoying the benefits of the convention. Spain, Italy, and Sweden were exempted from obligation (1) and (2) above, so long as they exported no sugar. As regards article (3), Great Britain chose prohibition. Article (4) means in practice issuing ‘certificates of origin’. It was not to apply to British India or the British self-governing colonies. An ‘Additional Act’ was signed at Brussels on August 28, 1907, to come into force on September 1, 1908. The main provisions are as follows. (1) The Convention is to remain in force for five years from September 1, 1908 — but any State may withdraw after September 1, 1911, on giving one year's notice, if the Permanent Commission at its last meeting before September 1, 1910, decides by a majority of votes that such power should be given to the contracting States. (2) Great Britain is relieved from the obligation to prohibit or penalize the importation of bounty-fed sugar. Sugar refined in Great Britain and exported may have to be accompanied by a certificate stating that no part of it comes from a bounty-giving State; otherwise it will be liable to be penalized. The signatory powers are Germany, Austria, France, Belgium, Holland, Great Britain, Italy, Luxemburg, Peru, Sweden, and Switzerland. [S J C]

Boussingault, Jean Baptiste Joseph Dieudonne, a famous French chemist, who devoted much of his great ability and learning to agricultural research and experiments. He was born in Paris in 1802, and educated at the Mining School of St. Étienne. After spending some years in South America as a mining engineer or chemist, and travelling in that part of the world, nominally as a soldier but really as a scientific observer, he returned to France and became Professor of Chemistry at Lyon. Later on he became Professor of Agriculture at the Conservatoire des Arts et Métiers in Paris. In 1839 he was elected a member of the Academy. He died in 1887. He was a prolific writer on Agriculture during the latter half of the 19th century. One of his most famous works, Économie Rurale, was published in 1844, the English translation (by George Law) being published in 1845. His Agronomie, Chimie Agricole et Physiologie was published in 1860–84, and comprised 7 vols. [W. E. B.]

Bovine Tuberculosis. See TUBERCULOSIS.

Bowels and Bowel Diseases. — The bowels represent that portion of the alimentary canal or digestive tube which extends from the 'outlet' or pyloric end of the stomach, and ending at the anal aperture. They are divisible into two main divisions, viz. the 'large' and the 'small' bowels; and these are again subdivided by anatomists into various portions, though chiefly for convenience of study and not as a useful means for the diagnosis of disease in animals. In the horse the cavity of the belly is mainly occupied by the bowels, and in this animal their capacity is very large, as the stomach is comparatively small, the converse applying to the ox, sheep, and goat. In all animals the bowels are maintained in their position by means of a delicate serous membrane, known as the mesentery, which is also reflected over the outer surface of the intestines, forming what is termed the 'serous coat', *i.e.* their outermost investment. This same membrane lines the cavity of the belly, and is called the peritoneum, and this structure very often participates when the bowels are the seat of inflammatory changes, either of an acute or of a chronic nature.

The peritoneum is reflected over certain organs, such as the liver, kidneys, womb, &c., and in the two first named it forms their capsular covering. Upon the belly-cavity side of the midriff, *i.e.* the muscular partition separating chest and belly cavities, the peritoneum is also reflected, and in cattle tuberculosis this structure is commonly the seat of 'grapy deposit' or nodular new growths. Both peritoneum and mesentery (bowel sling) are richly supplied with bloodvessels, in fact it is by these structures that the bloodvessels are led to the bowels.

The small bowel of the horse is divided into three parts — the duodenum, the jejunum, and the ileum. The first named begins at the stomach and is about a couple of feet long, the jejunum 30 ft., and the ileum 40 ft. in length, the latter ending in a blind portion of the large bowel, known as the cæcum. The opening of the small bowel into the last named is on its concave curvature, and a valve-like arrangement — technically called the ileo-cæcal valve — guards its inlet, thus preventing regurgitation of fluids from the cæcum into the small gut.

The large bowel is divisible into the cæcum, the double colon, the single or floating colon, and the rectum or straight gut, the last named ending at the anus. The total length of the large gut is about 25 ft., of which the cæcum measures 3 ft., with an average capacity of 6 gal. The cæcum is easily known by its crook at one end and the blind point at the other. The large or double colon begins at the crook of the cæcum, and is doubled upon itself, being about 11 ft. in length, while it has an average capacity of 16 gal. Longitudinal muscular bands and furrows are seen upon the outer face of both cæcum and colon. The double colon ends in the single or floating colon, whose length is about 10 ft., and this is followed by the rectum, with a length of about 2 ft.

In herbivorous animals the bowel is *generally* long, but in the Carnivora short. The *wall* of the gut is composed of four coats or layers, arranged as follows, from without: (1) the serous; (2) the muscular; (3) the submucous; (4) the mucous or inner lining.

We have already referred to the serous, and the muscular coat consists of plain or involuntary fibres, arranged in two layers, the outer being longitudinal, and the inner circular, though both encircle the gut. By contraction the former shortens the bowel, and the latter narrows the passage of the bowel when thus acting. The submucous coat serves to connect the three coats, whilst the mucous coat or lining of the bowel has a soft appearance, due to the innumerable villi and tubular glands entering into its structure. It has a rich blood supply, and readily absorbs the nutritive constituents of the food.

In the duodenum of the horse — and in other animals — there are numerous small glands, Brunner's glands, absent in other portions of the bowels. In the sheep the small intestine is very thin. Ducts from the liver and pancreas (sweetbread) open into the duodenum, to convey the bile and pancreatic juice, for digestive and other purposes. A peculiar feature about the mesentery of ruminants is that the large and small bowels hang as it were between the same two layers of the mesenteric sling.

Between the layers of the mesentery are the lacteal and absorbent vessels, which play such important functions in the nutrition of the animal. The absorbent glands are arranged in groups at the roots of the mesentery and elsewhere throughout the body. The nerves pass to the bowel between the folds of the mesentery, as in the case of the bloodvessels. If the bowels are noted immediately after death, on section of the abdomen, it will be seen that they are endowed with some degree of motion. This vermicular action is the result of a muscular wave passing along the wall of the gut, known as the peristaltic action. Such peristaltic movement can be heard during life, and shows that the bowels are fully active. In torpid conditions the sound is in abeyance, and its return is indicative of renewed activity in the alimentary canal. The acid secretion of the stomach glands is neutralized when it passes into the beginning of the small bowel (duodenum), where it blends with the bile and pancreatic juice, becoming more alkaline as the cæcum is approached. The contents of the small bowel are generally very fluid, and this favours absorption, and also hastens the indigestible matters on to the large bowel, until the single colon and rectum are reached, where the fæces are formed, moulded, and then passed out of the body. The contents of the cæcum (blind gut) are always fluid, and those of the double colon semi fluid. In the horse the fæces are solid, and their expulsion is assisted by the bile. In the ox the fæces are soft and pultaceous. In sheep the fæces are dry.

The diseases and disorders affecting the bowels of the horse are much more numerous than those of the ox, sheep, pig, or dog, and the commonest of such disorders is that known as—

Colic, *fret*, *the bats*, *gripes*, &c., all being used as synonymous terms. This complaint comes on quite suddenly, and sometimes disappears equally suddenly, although no treatment may have been adopted. If accompanied by distension of the belly with gas, it is spoken of as *flatulent colic*—a much more serious matter, especially if due to fermenting green food. Overdriving, drinking too much cold water when overheated, turning a horse to grass without previously giving a dose of physic, the presence of worms, concretions, and indigestible food, or an overdose of physic, are the chief causes of this complaint. (See Colic.) The large bowel in particular is frequently the seat of one or more concretions or calculi, which often produce not only colic, but also inflammation of the bowels. These foreign bodies vary in their size, shape, &c. (See Calculus and Crockles.) In all animals, internal parasites are an extremely common cause of illness, in fact one of the most frequent causes of death amongst farm stock. See Worms.

Rupture of the bowel is a very uncommon accident, but when it does occur it may be either the small or large bowel that is the seat of the lesion. It is usually the result of a penetrating wound of the belly, though it may arise through *disease of the wall of the bowel. In either case*, the contents of the gut escape into the belly cavity, and set up inflammation. It is necessarily a fatal injury. (See Rupture.) The horse, dog, and pig suffer from inflammation of the bowels much more frequently than either the ox, sheep, or goat, and in the two first named it is frequently brought on by worms, and the inflammation is always fatal. Either the large or small bowel may be the chief seat of the disease, but the pain is usually more severe when the large gut is chiefly involved. A frequent cause of the disease in the horse is 'twisted gut' or 'intussusception' of it. (See Intussusception.) Concretions sometimes block up the bowel, and so give rise to inflammation. Irritant poisons and the poison of *anthrax* are not uncommonly operative in its production. Hot fomentations should be applied to the belly and veterinary aid obtained at once. See Enteritis.

Other intestinal troubles are dealt with under the articles Diarrhœa (excessive discharge from the bowels); Dysentery (bloody discharge); Constipation (torpidity of the bowels); Impaction (stoppage); Tuberculosis. [F. T. B.]

Bowing of Cows.—According to a practice common in the south-west of Scotland, this is a contract whereby the proprietor or tenant of a farm who owns a stock of cows lets to a party, called the 'bower', the 'bowing' or produce of the herd together with the privilege of grazing them on the farm. Arrangements are usually made for shifting the pasture, for the accommodation of the cattle in byres, and the use of the dairy and dairy utensils. It is also usual to stipulate as to winter feeding allowances at the farm, and sometimes for the services of the farm servants. The rent is usually fixed at so much for each cow. The owner or principal tenant remains the owner of the cows, and bears the risk of their becoming unfit for dairy purposes through any unforeseen causes, in which case he is bound to exchange or replace the cow so becoming unfit by another. In the same way it has been held that if one of the cows dies or becomes ill the lessor is bound to replace it immediately, and failing his doing so, he will be liable to the bower in damages for the loss of the milk. The lessor remains liable for the public burdens, and, as owner of the cows, is the party who is responsible for not reporting an outbreak of contagious disease. It is usual to stipulate that the dung made from the said dairy shall belong to the owner without payment.

[D. B.]

Box Elder. See Negundo.

Boxthorn. See Lycium.

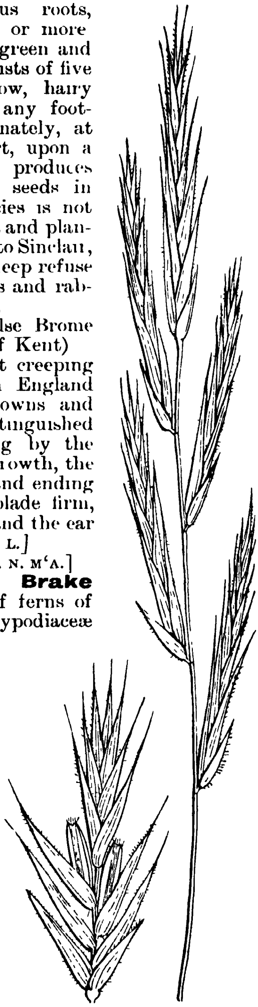
Boxwood (Buxus), a genus of the Euphorbiaceæ, consisting of evergreen shrubs or small trees. The only European species, the common Box or Boxwood (*B. sempervirens*), occurs in parts of southern England (Surrey and elsewhere) in small local patches on limy soil, but it is not known whether it is there really indigenous or only introduced (perhaps by the Romans). Elsewhere it is to be found chiefly in hilly limestone tracts throughout southern Europe, and *thence to south-western Asia and along the* Himalayas, and on into Japan. But everywhere its spontaneous appearance is usually very local. Its dense, thick, shining, small ovate leaves and numerous branchlets, its compact growth, its ready endurance of clipping, and its great longevity render it very suitable for old-fashioned 'topiary' gardening, while a dwarf variety of this species is the most common plant used for edging in gardens. It is the heaviest of all European woods (sp. gr. 1·28 green, 1·10 seasoned). The wood is yellow, hard, and takes a fine polish, and is used for engravers' blocks, surveyors' scales, cabinetmaking, and inlaying. It is here only cultivated for ornament, although formerly it had a distinct commercial value. But the last large transaction in its wood was at Box Hill in Surrey, when Sir Henry Mildmay, then in possession of the estate, sold all the boxwood upon it in or about 1801 for £15,000, the buyer being allowed fourteen years to cut and remove it. Forty tons were cut in 1802, with the result that the throwing of so large a quantity on the London market lowered its price by about 50 per cent. Box is hardy, and may easily be grown from seed collected immediately the capsules begin to open, and sown at once in rich, light, well-drained soil, or from cuttings of 4 to 6 in. long, or from layers. Box edgings are best planted in spring, and bear cutting at any time except midwinter.

[J. N.]

Brachypodium, a genus of grasses belonging to the division with many-flowered spikelets, and glumes shorter than the lowest floret. In this division, Brachypodium is recognized by the presence of an awn at the point of its lower pales, and by the sessile spikelets arranged alternately upon a simple axis

B. sylvaticum (Slender False Brome) – This is a hairy, upright, perennial grass, with fibrous roots, growing 2 ft. high or more Its leaves are pale-green and rough. Its ear consists of five or six long, narrow, hairy spikelets, without any foot-stalk, placed alternately, at some distance apart, upon a slender rachis. It produces ears in July, and seeds in August. The species is not uncommon in woods and plantations. According to Sinclair, oxen, horses, and sheep refuse to eat it; but hares and rabbits crop the leaves.

B pinnatum (False Brome Grass, Tor Grass of Kent) This is a somewhat creeping species common in England on poor chalky downs and pastures. It is distinguished from the preceding by the creeping habit of growth, the ligule rounded off and ending in hairs, the leaf-blade firm, not hanging limp, and the ear not drooping. [J. L.]
[A. N. M'A.]


False Brome Grass (*Brachypodium pinnatum*)

Bracken or **Brake** (Pteris), a genus of ferns of the sub-order Polypodiaceæ (nat. ord Filices), with many species The Common Bracken or Brake (*P. aquilina*) derives its specific name from the slight resemblance to a spread-eagle that is represented by the fibro-vascular bundles when the frondstalk is cut across obliquely. Its ancient name of 'Christ fern' was also derived from a similar resemblance to the letters J C, presented on making a section of the rootstock. It is the commonest, largest, and handsomest of our indigenous ferns, and is also to be found in most of the temperate parts of both hemispheres. It grows extensively on heaths, hillsides, parks, and woods all over Great Britain and Ireland, its fronds often reaching to a height of 5 or 6 ft. The fronds are bipinnate, but owing to the first two leaflets being each as large as the remainder of the frond, and to this latter portion being bent back into much the same plane as the other two, this gives the whole frond a characteristic three-branched appearance. Often growing profusely in large patches on uncultivated hillsides and neglected rough pastures with good natural drainage, and frequently forming the soil-covering in thin highwoods on light, sandy soil, it forms a pleasing and picturesque object, especially when the fronds become russet-brown with the early autumn frosts; but it is not a profitable way of utilizing the land; for where bracken will grow, timber plantations can almost always easily be made with a fair chance of profit. Its chief use is as litter for cattle, but in summer it forms a good cover for deer, and in winter for smaller game Before planting bracken-covered wastes it is necessary to clear it away sufficiently to prevent its outgrowing the young plants and afterwards overlaying them when it dies down in autumn. This can be best obviated by cutting the fern back in spring, when the fronds are nearly unrolled, but have not fully entered into their assimilative functions Switching the fronds then saps the strength of the rootstock; and if this operation be repeated for a couple of years, there is little chance of the young timber crop being damaged by overshadowing and smothering after planting takes place Bracken is a pest on hill pastures, and its mode of life makes its extermination difficult. By its underground rhizomes it encroaches on and occupies the best of the upland pastures and usurps the place of the best pasture grasses. To effect its eradication, it should be cut early in the season by the scythe (or by a thistle-cutter) The cutting should be repeated as often as the young fronds attain sufficient size to render this practicable. [J N.]

Bracken-Cutter. See Thistle-Cutter

Bradley, Richard, is noted as being one of the first writers to point out the bearing of other sciences upon the facts and problems of agriculture and horticulture Of his writings, which were very extensive, the following may be mentioned A Philosophical Treatise of Agriculture (1723); A Survey of Ancient Husbandry and Gardening (1725); A Complete Body of Husbandry (1727), The Science of Good Husbandry (1727). [I. B.]

Braekel Fowl.—In no country is the breeding of various forms of live stock more understood than in the Low Countries, in which we include Belgium and Holland. This is more especially true in the former, as there the peasants are among the most skilful breeders in the world. The quality of poultry kept upon the farms is very high indeed, and there is great uniformity in the different districts. We do not know of any section of Europe where the evolution of races as a result of natural influences has been better used for the benefit of man. The very conservatism of the Belgian people has tended to the retention of types and races specially suitable to the respective districts. The Braekel is very closely allied to another Belgian fowl (see Campine Fowl). In fact, originally they were one and the same, and such differences as are to be noted arise from the differing districts and conditions under which they have been bred. The Braekel is chiefly found on the rich lands in the west of Flanders, as a result of which the tendency has been to increase the size of body, whereas the Campine has had its habitat on the arid sands of the Campine country, in itself sufficient to explain the smaller size. In shape the Braekel is square, carrying the chest well forward, but, as in most of the purely laying races, the body is deeper behind than before. The legs are of medium length, light in bone, and slaty-blue in colour. The neck and the tail are full, that is well feathered, and the bright, active-looking head is surmounted by a single comb, fairly large in relation to the size of body. The body feathers are pencilled with bars of black, but these are coarser than in the Campine and less regular. There are two colours, namely the gold and the silver. In the former the ground colour is golden-yellow, and in the latter creamy white. In both varieties the males show only the barring or pencilling on the body, wings, and tail, the neck hackle, back, and saddle hackle being self-coloured in accordance with the variety; in the females the neck and neck hackle alone are self-coloured. In size of body these birds vary to a considerable extent, and, as is generally the case with heavy layers, the more productive are not the largest, but the reverse. Cocks weigh from 5 to 7 lb., hens from 4½ to 6 lb., in all cases nearer to the former rather than to the latter. Some pure-white Braekels are to be found, but these have not become popular to any great extent, and also a few chamois or buff specimens are met with. These latter, however, would not appear to be as pure as the former, as yellow is not a natural sport from a gold variety, as would the white from silver.

The great quality of the Braekel is their wonderful egg-production, as in this respect they have few equals. Not only do they lay a large number of eggs annually, but these are large in size, pullets laying eggs quite 2 oz. in weight and often above. The eggs are pure-white in coloration of shell, and are fine in flavour, as might be expected from birds kept on the fine pastures of West Flanders. In the Belgian markets these eggs command the best prices, and are generally preferred to any other with white shells. Further, the precocity of the chickens is greatly in their favour, for they mature very rapidly indeed, and as at this early stage they are fleshy, they are largely used for making the *poulets de lait*, or young chickens, which are so greatly in demand at Brussels and other great centres of population in Belgium. This is the only period at which the Braekel can be claimed to have good flesh properties, for as they grow older and more mature the flesh becomes fibrous, is less abundant, and lacks flavour. At the early stage referred to, the chickens can be fed up for killing very rapidly. It is in this way that the cockerels are disposed of, but the leading merit of the breed is its excellent laying qualities. [E. B.]

Brahma Fowl.—At one period the influence of this race of fowl was very great, and it is not too much to say that the majority of farm poultry in Britain had more or less connection with it. That is, however, no longer the case. In fact, to a large extent the Brahma is no longer known as a breed for utility purposes, and the great majority of those bred are destined for the exhibition pen. Strange to say, that is not the case in America, where this breed is used extensively for the production of winter table poultry. The reason is, that whilst across the Atlantic the Brahma is bred very much on the original lines, in this country the economic properties have been sacrificed to merely arbitrary and useless characters, such as feather, with the result that it has lost much of its value as a profitable breed. It is questionable whether in competition with the newer races of fowls the Brahma would have maintained the pre-eminence it held thirty years ago, even had the changes referred to not taken place; but that these have led to its becoming practically a fancy fowl is undoubtedly true. With a rapidly reproducing race like poultry, the tendency to what is called 'working out' must always be seen earlier than with slower breeding and growing animals. If this is emphasized by false systems of selection and breeding, the effect is speedy. Hence we find that the excessive development of hock, leg, and foot feathering, and the sacrifice of everything to coloration of plumage, has injuriously affected the productiveness and flesh qualities. Breeders admit that in both these directions the Brahma is not nearly as good as it was formerly. Feather is about the most expensive part of the body to produce, and when this is found to so large a degree upon the legs and feet, it is objectionable in appearance, and tends to slowness of growth of the chickens. Yet the breed retains some good qualities, such as vigour of constitution and winter egg production. If breeders would boldly discard the heavily feathered type, and revert to the older form, the Brahma would have a useful place among our domestic poultry.

Of this race there are two varieties, the light and the dark. In the former the plumage is of a silvery white, with black stripes in the hackles, and the wings are black edged with white, the tail and tail coverts solid black. In the latter the breast, wings, under parts, thighs, and fluff, as also the leg and foot feathers, are deep black, in some cases slightly mottled with white. The dark hens differ greatly from the cocks in that, whilst the ground colour is dark, each feather is pencilled with silver white. The birds are large in body, males attaining 11 lb. and more, and hens 9 lb. They are massive in appearance, increased by the heavy leg, hock, and foot feathering, and the breast is very broad, the chest being well carried up. The back is short, neck and tail rising almost abruptly from it, both carried very upright, giving the appearance of a short neck. The head is small and short, and the comb is what is called 'Pea', that is, consisting of three ridges carried close to the head, the centre ridge a little higher than the other two. The wattles are small and round. In bone the

Brahma is heavy, more so than was at one time the case, and both the shanks and flesh are yellow. Proportionally to the total weight the quantity of flesh is small, and it is lacking in quality and tenderness. The egg shells are well tinted and round, rather small in size. [K. B.]

Brahmin Bull. See ZEBU.

Brain Diseases.—The domesticated animals are subject to but few brain diseases, and in only rare instances can it be said that individuals become insane. The most serious of cerebral troubles is that of rabies (see RABIES). Under the title of MEGRIMS and of STAGGERS the more common brain disturbances are described. Morbid growths give rise to pressure upon the brain, and in the case of horses lead to serious accidents if not detected in time. Tumours in this situation will be found under the heading of TUMOURS AND GROWTHS.

Inflammation of the covering membranes (meningitis) is met with as a result of injuries, and occasionally as a sequel to specific diseases, as tuberculosis and influenza, and in the dog, distemper. [H. L.]

Braird, the first appearance of a crop above ground. When the young leaves of sown crops are vigorous and promising, they form what is technically called a good braird.

Brake. See BRACKEN.

Brake Horse Power. See HORSE POWER.

Brakes.—The comparatively slow motion and light weight of machines used for agricultural purposes render it unnecessary to employ brakes involving the complicated construction and great power used in some industries, especially in railway locomotive works, lifts, &c. Railway locomotion has called forth great skill and ingenuity to provide means for retarding trains when travelling at high speed, but such conditions have not to be met on the farm, consequently the hydraulic, electric, and air and vacuum brakes need not be considered here. Ordinarily, brakes consist of means to apply pressure and friction to rotating or revolving bodies so as to retard or entirely stop their motion. The skid or sabot, the iron shoe into which a wagon wheel is run when descending inclines, acts as a brake as it stops the revolution of the wheel, and friction is produced between the skid and the road. In this case no mechanical means of supplying pressure is required, as the weight of the vehicle produces sufficient friction to hold it in check. A chain attached to the axle and looped round the rim of the wheel brought tight against one of the felloes, acts as a brake by checking the revolution of the wheel, the friction of a portion of the tire of the wheel against the surface of the road keeping the vehicle from accelerating its speed. This has the great disadvantage of causing undue wear on the tire. As a rule, however, resistance is supplied by the aid of blocks brought into contact with the moving body by means of levers actuated by hand pressure. For light vehicles a single block is sufficient, but where the load is heavy or where the speed is high, a series of blocks attached to a steel band, so as to encircle a considerable portion of a wheel or drum and act collectively, are more suitably employed. Any of the simple forms of lever can be used to bring a block against the rim or tire of the wheel, the handle being kept in position by placing it in a suitable notch until it is desired to release it. In the place of a lever, a handle and screw may be used to force down the block on to the rim.

When a series of blocks of wood or metal carried on a circular band are used to form a friction band, two straps of iron movable round a fixed point are united at the other ends to a handle, forming a bell crank. When pressure is applied by the handle, causing the encircling band to come into contact with the rim, friction is produced. As the action of the bell crank is to produce the power of the toggle joint, great effect results from a small amount of pressure. Occasionally the bell crank is not employed, but a band of steel attached firmly at one end near the wheel, and partly encircling it is attached at the other end to a lever, which can be made to exercise sufficient pressure to produce the necessary friction; but it is obviously less effective than where the bell crank is employed. On farms it is not at all uncommon to see friction bands which are used to actuate parts by supplying a temporary grip, oiled to make them more effective, with the natural result that they lose all effectiveness. Many horse rakes, where the raising of the teeth has been actuated by friction bands, have been cast aside for no other reason than this. [W. J. M.]

Bramble. See RUBUS.

Bran.—Bran is one of the principal 'offals' of wheat, and consists of the outer skin of the grain. It is the coarsest of the offals, these comprising in order the following, beginning with the coarsest: bran, pollards, sharps, middlings.

The production of the different offals of wheat has undergone considerable changes consequent on the introduction of modern methods of milling. The general impression among stock-feeders is that the newer methods of roller-mills do not produce as good offals for feeding purposes as did the old ones, when stones were used for grinding the corn. Also the number and kinds of offals prepared at any time will depend largely on the demand at that time for any one or more particular offal. Thus, in the case of bran, a very coarse bran finds favour especially for horses, and will fetch 20*s.* to 30*s.* per ton more than a finer bran. The finer bran is used mainly for dairy cattle, and is largely exported, Germany and Holland being the principal receiving countries. In the coarser kinds of bran a larger amount of the flour is left attaching to the husk.

Bran is a favourite food for horses, and when made into a 'mash' has a slightly laxative effect. Probably the greatest use of bran is for milking cows, and it is reckoned as one of the very best of the cereal products for butter-production. Undoubtedly it is a very valuable material on the farm, and one that ought not to be allowed to go away from it.

The nitrogenous matter contained in bran is in the form of gluten. Bran also contains a peculiar kind of mucilage, the mineral matter or ash is particularly rich in phosphates. The following analysis shows its general composition

Water	13·2
Fat	3·7
Albuminoids	12·1
Amides	2·0
Soluble carbohydrates, &c	56·0
Woody fibre	7·2
Ash	5·8
	100·0
Nitrogen	2·5

Of the nitrogenous matter 78 per cent is digestible, 76 per cent of the soluble carbohydrates, and about 30 per cent of the woody fibre The ratio of nitrogenous to non-nitrogenous bodies is 1 4·6.

Analysis of the ash constituents shows these to be, in 100 parts of bran, 3·6 per cent of phosphoric acid and 1·45 per cent of potash, so that the ash is very rich in the former constituent The nitrogen in bran amounts to about 2·5 per cent, and the manurial value is considerable According to Lawes' & Gilbert's tables, as modified (1903) by Voelcker & Hall, the compensation for unexhausted manurial value is, for each ton of bran consumed —

For the last year	Second year	Third year	Fourth year
28s 11*d*.	14s 5*d*	7s 2*d*	3s 7*d*

[J A V]

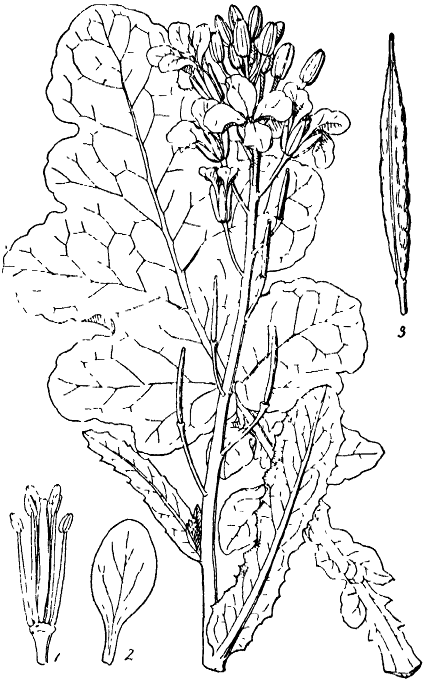
Branding or **Buisting,** the stamping upon sheep of their owner's initials Rams frequently have their owner's initials branded on the horn. This is done by means of a hot branding iron which has the letters in the form of a die. What is properly known as 'buisting consists in stamping the initials on the sheep's side by means of an iron having the initials in entire relief, dipped in a mixture of hot tar Lampblack is sometimes added to the tar to make the buist mark more permanent The branding iron requires to be of the best iron to resist the frequent heatings to which it is subjected, but the buisting iron does not require to be of special quality [J B]

Brassica, a very extensive genus of the nat ord. Cruciferæ, comprising about a hundred species They are herbaceous plants, having yellow or white flowers in racemes or corymbose inflorescences, the fruits being elongated siliques containing one row of oval or subglobose seeds The embryo within the seed has two cotyledons, which are folded down the middle, the rootlet or radicle lying within the fold. In the embryo is stored a large amount of oil, which in rape, colza, mustard, and other species is expressed, and used for burning in lamps and for other purposes.

The genus is divided into two sections Section I, *Brassica* proper, has erect sepals; Section II, the old Linnæan genus *Sinapis*, which embraces the mustards, has flowers with spreading sepals It is only necessary here to refer to the most important representative species and their varieties, which are cultivated by farmers and gardeners.

SECTION I.—*Brassica*, L.

1. THE WILD CABBAGE (*Brassica oleracea*, L.) is usually a biennial plant, but may live three or four years before dying. It is met with on cliffs on the sea coast in the south and west of England and other temperate parts of Europe. The wild cabbage has a stout semi-woody stem and rootstock; its leaves are smooth and glaucous, the lower ones lyrate and fleshy, the upper ones oblong and sessile The flowers are pale creamy yellow, often nearly an inch across. This species has given rise to an extraordinary number of races or varieties, which have become more or less fixed by selection. Almost every organ of the plant—root stem, leaf, and flower—has been modified The seeds of these different races, however, are very similar, and resemble those of the wild species; they are roundish or slightly oval, with a rather dull greyish-brown coat



Wild Cabbage (*Brassica oleracea*)

1 Stamens and pistil 2 Petal 3 Fruit (siliqua)

The cultivated forms are biennial, and may be arranged in six fairly distinct races, each of which includes many minor varieties. The young seedling plants of all of them are glaucous and quite smooth or glabrous.

RACE I (*B oleracea*, L, *acephala*) - -The representatives of this race have many small buds, which grow out at once into elongated leafy stems and branches which provide a large amount of green food. They most closely resemble the unmodified wild cabbage.

Examples are the borecoles, coleworts, and kails, largely grown in gardens; some have green leaves, others purple or pinkish, the margins of which may be simply waved or very much divided and fringed.

Thousand-headed Kail, Jersey Tree Cabbage, and Cow Cabbage are coarse varieties grown as sheep and cattle food. In this race may also be included the Portugal Cabbage or *Chou Tronchuda*, which has a shorter thickened stem bearing large leaves with peculiarly thickened tender ribs.

Race II (*B. oleracea*, L., *gemmifera*).—These have erect unbranched stems bearing small axillary buds, which become compact and round, from ½ to 1 in. in diameter. The chief form in this group is the Brussels Sprout.

Race III (*B. oleracea*, L., *capitata*). In this race the stem remains short, and the terminal bud during the first year of growth develops to a large size. A 'head' or 'cabbage' is formed, which may be flattened, spherical, or somewhat conical or heart-shaped. The 'white' and 'red' or purple cabbages of gardens and fields are included in this race.

Race IV (*B. oleracea*, L., *sabauda* or *bullata*).—The representatives of this group resemble those of the previous one in having well-developed 'heads', but the leaves are puckered or wrinkled. They are known as Savoy cabbages, 'white' and 'red' or purple kinds are met with.

Race V (*B. oleracea*, L., *gongylodes* or *caulorapa*). In this race the stem of the plant above the cotyledons has become modified, and grows into a roundish, fleshy, spherical body resembling a turnip in shape. When fully grown the lower leaves fall off, leaving well-marked leaf-scars on the thickened 'bulb'. The varieties are known as kohlrabi, or turnip-rooted cabbages.

Race VI (*B. oleracea*, L., *botrytis*).—Varieties in this group produce during their first season's growth a much-thickened but tender flowering axis, with fleshy white branches, all of which are at first crowded together into a dense whitish 'head'. The delicate forms, which are readily injured by frost and are grown in gardens in summer, are spoken of as cauliflowers, the hardy later sorts being termed Broccoli.

2. Turnip (*Brassica Rapa*, L.).—A biennial species, the seedling plants of which are very hispid, or covered with stiff, bristly hairs, and grass-green in colour. The hypocotyl and root thicken into a 'bulb', which may be a flattened sphere, round, or elongated to 'tankard' and carrot shapes. The leaves at this stage are also green and hispid, lyrate in shape, and crowded at the apex of the 'root' on a short stem, the internodes of which are scarcely visible.

The flowering stem is sent up in the second year of growth. It bears upon it amplexicaul leaves, acuminate, sub-glaucous in colour, and smooth. The flowers of the white-fleshed varieties are pale canary yellow, somewhat small, with spreading calyxes; those of the yellow-fleshed sorts are somewhat darker yellow, with a tinge of buff in them. Although yellow-fleshed turnips are probably merely varieties of the turnip, they are often termed 'hybrid' turnips by farmers and seedsmen, and said to be hybrids between the yellow-fleshed Swedish turnip or 'Swede', and the white-fleshed turnip. There is no satisfactory evidence to support this view, and the 'hybrids' produced by the author by crossing these two plants were white-fleshed, quite sterile, and unlike the yellow-fleshed turnip.

A plant is frequently met with in a semi-wild state, and also cultivated in France, Germany, and other parts of the Continent for the oil yielded by its seeds, which resembles the turnip in leaves, stems, flowers, and seeds; but it is an annual (?sometimes biennial), and does not form a thick, fleshy 'bulb' or 'root'. It is a wilding *B. Rapa*, or *B. campestris* of Koch.

3. In addition to the cabbage (*B. oleracea*, L.) and the turnip (*B. Rapa*, L.), with its non-bulbing relative just described, there are a number of cultivated plants belonging to the genus Brassica whose relationship to each other is very obscure, and whose botanical nomenclature is very confused. In this list are —

(*a*) The Swedish Turnip, or 'Swede' as it is popularly termed by farmers. This plant has bluish-grey or glaucous leaves, resembling those of the cabbage in colour, but the leaves of the seedlings are slightly hispid or bristly, especially on the veins.

The 'root' or 'bulbed' fleshy part of the plant is not so round as that of the turnip, and the leafy stem on the upper part of the root has longer internodes, forming a 'neck', on which the scars of the old leaf-bases are clearly marked.

As regards the colour of the flesh, two kinds of Swede may be distinguished, viz.:—

(i) White-fleshed Swedes (*B. napobrassica*, Dec.), with white flesh and canary-yellow flowers.

(ii) Yellow-fleshed Swedes or Rutabagas (*B. Rutabaga*, L.), with flesh of reddish-yellow tint and flowers buff yellow.

(*b*) Allied to the Swedish turnips are several cultivated forms of Brassica, with their roots not swollen and fleshy, which are grown for the oil contained in their seeds. The form most nearly resembling the white Swede, in having glaucous leaves, which are hispid when young, has canary-yellow flowers, and is spoken of as Colza, Coleseed, or Rape. It appears to be the *Brassica campestris* of Linnæus.

(*c*) There is said to be another form of Rape or Colza, grown for its oil-yielding seeds, which very closely resembles that just described, but with *smooth*, glaucous leaves. This is probably the *Brassica Napus* of Linnæus.

Section II.—*Sinapis*, L.

The sepals of the flowers in this section are spreading. Three species may be mentioned, viz.:—

1. Black or Brown Mustard (*Brassica nigra*, Koch; *Sinapis nigra*, L.) is an annual plant with rough slightly glaucous stem, and lyrate, rough leaves below, and linear-lanceolate, smooth leaves above. The flowers are yellow. The

pods when ripe are erect, lying close to the flowering stem, and contain small red wine-coloured seeds which are used in the manufacture of table mustard.

2. CHARLOCK, KEDLOCK, KILK, OR WILD MUSTARD (*Brassica Sinapis*, Vis ; *Sinapis arvensis*, L.) is an annual pest on many farms. It resembles Black Mustard somewhat in its leaves and flowers; but its pods are spreading and not adpressed to the flowering stem, and the seeds are smoother and darker in colour.

3. WHITE MUSTARD (*Brassica alba*, Boiss.; *Sinapis alba*, L) is an annual with lyrate, pinnatifid or pinnate rough leaves and yellow flowers. The pods are spreading, and bear at their ends a curved, flattish 'beak'. The seeds, which are pale creamy yellow, are used in the manufacture of table mustard [J P]

Bratting Sheep, a method formerly adopted for protecting sheep during severe weather by means of a 'brat' or cloth fastened round the body. The cloth was kept in place by five cords tied round the chest, buttocks, before the hind legs and behind the fore legs, and round the belly. The advantages of bratting are altogether outweighed by the trouble and expense involved, and it has now been abandoned as a general practice. [J B]

Brawn.- In times past this was a very favourite dish in the country districts during the autumn or early spring, when the annual pig killings took place. The following manner of preparing brawn is given in a Treatise on the Breeding of Swine, written by Robert Henderson and published nearly a century since It runs 'Brawn is the flesh of a boar soused or pickled, for which end the boar should be old, because the older he is the brawn will be more (*sic*) horny. It is the flitches only, without the ham or shoulder, that are made use of for this purpose. Brawn is prepared in the following manner: After the boar is killed, the flesh is to be sliced off the backbone and ribs, and afterwards sprinkled with salt, it must then be laid in a tray till the blood be drained from it, then give it a little more salt and let it be rolled up as hard as possible. The length of the collar of brawn should be as much as one side of the boar will bear, so that when rolled up it will be 9 or 10 in. in diameter. After being rolled up, it must be boiled in a copper till it is so tender that you can run a straw through it; then lay it aside till it is thoroughly cold, when it must be put into the following pickle To every gallon of water put a handful or two of salt and the same quantity of wheat bran; boil them together, drain the brawn as clear as you can from the liquor, and when it is quite cold put the brawn into it.'

A more recent and a more precise recipe for the manufacture of this old-time dish is given in Douglas's Encyclopædia as follows· 'Clean fresh pigs' heads well, and bone them out. Commence with the cheeks first; take out the jawbones, then the tongue, and then the eyepieces. Get a small barrel and dust it with the following mixture: 5 lb. salt, ¼ lb. saltpetre, ½ lb dry antiseptic. Rub the tongues, more especially at the roots. Put the tongues into the barrel first, then the cheeks, after dusting them over with the mixture, and lay them well over one another *rind to rind.* Use the small pieces to fill in between. Between the layers dust freely the mixture, so that each portion of meat receives a covering. Keep the meat in the barrel for from twenty-four to thirty hours, then put it into a jacketed pan or boiling copper with just sufficient clear water to cover the meat. Boil for an hour at 212° F., then remove on to a fine sieve and strain out the jelly. Now cut the meat as nearly as possible into squares by means of a knife, or, better, by means of a brawn-cutting machine. When this is done, put your cut pieces into glass moulds or other suitable dishes, and fill up with the jelly previously strained off, and allow to cool. Some prefer to keep some tongues separate and cut them into long pieces These they stick down into the meat before the jelly is added. Some put in whole tongues Seasoning for this brawn should be added when the brawn is being boiled, and should be made on the following plan. For every twenty heads use 3 oz of white pepper, ½ oz of cayenne, a thimbleful of essence of lemon. A few whole cloves and some peppercorns throughout give a nice flavour' This may appear to be a wholesale course of proceeding, but it is possible to carry it out with success on a small scale, and a most appetizing and inexpensive dish results. [S S]

Braxy in Sheep. Braxy in the local acceptation of the term has been used to signify a group of diseases of the sheep, occurring more especially in the back end of the year, and characterized by sudden death, with few well-marked premonitory symptoms. From distinguishing features, based upon certain clinical appearances, various forms of braxy were known as the Red Braxy, the Water Braxy, the White Braxy, &c, and as such were designated by the shepherds

For a long time, and in many places even at the present time, these were lumped together and looked upon by the shepherds and owners of sheep as one and the same disease, and it is only by means of the light shed upon them by recent investigations that we are able to say that each one, in all probability, represents a distinct and separate diseased condition. With these various diseases it is not our intention at this time to deal, but to confine our remarks to what is recognized scientifically in this and other countries as 'Braxy', namely, a disease caused by the specific microbe, the braxy bacillus.

DISTRIBUTION AND OCCURRENCE. — In the United Kingdom, braxy is specially prevalent over the west coast of Scotland, the north of England, and the west coast of Ireland. It occurs especially in the months of November, December, January, and February, and is of rare occurrence at other periods, in fact it may be looked upon as a distinctly seasonal disease

ANIMALS ATTACKED.—Braxy especially attacks sheep under one year old, and in well-marked cases it is almost invariably a fatal disease; but from the information now to hand, and as the result of experimental research, it appears probable that nearly all the young stock on an infected farm not showing marked symptoms of the disease, have during the months preceding its appearance in the virulent and fatal form passed through a mild attack, and thus acquired a natural immunity.

The percentage of deaths varies on certain farms and in certain years, but on badly infected farms its ravages among the 'hoggs' or 'tegs' may be averaged at from 10 to 40 per cent. These percentages, however, may be largely exceeded in a bad year if fresh hoggs from a healthy district are introduced in the autumn on to a known braxy farm. In such cases the death rate is something stupendous, and may result in the almost total annihilation of the young stock.

Two-year-old sheep in braxy districts seldom take the disease, and three-year-olds are said to be exempt. This fact is of extreme interest, and raises the question as to whether sheep acquire a natural immunity with age, and if so how is it brought about? And from the Report published by the Braxy and Louping-Ill Committee, under the chairmanship of Professor Hamilton, it appears that this is so, and on that basis the method of preventive treatment recommended and adopted by the Committee is founded.

CAUSATION. DESCRIPTION OF BACILLUS (HAMILTON). The cause of braxy is a specific organism designated the braxy bacillus. It averages in length about half the size of a human red-blood corpuscle, and is distinguished microscopically from others of its class by its comparatively small size and delicacy of contour. As found in the natural liquids of the body it has a great tendency to spore, the spore being of a brownish colour, very highly refractile, comparatively small, and situated near the end of the rod, to which it gives a somewhat lanceolate appearance. The rod is usually quite immobile, both when in the natural serous effusions of the body and in cultures on artificial media. When the peritoneal or other serous effusion is incubated at a temperature of 38° C., nearly the whole of the rods will be found to have vanished and the number of free spores to have correspondingly increased. In giving birth to a spore under these circumstances, the mother bacillus seems to perish and is bacteriolyzed. Thus incubated the spores may be retained for a number of years, and will still reproduce the disease with almost perfect certainty if the liquid is kept in sealed tubes or sterile bottles. Boiling of the spores for five minutes usually kills them, but they will retain their vitality at a temperature of 80° C for twenty minutes.

The bacillus stains with the ordinary aniline dyes, but these to a great extent mask its characteristic appearances, which are best seen when it is examined unstained in the living state, suspended in the serous liquid on which it has been growing.

CULTURE OF THE BACILLUS. — This is best obtained on alkaline glucose beef-tea, under oil, and incubated at a body temperature for thirty-six hours. At the end of this time all germination should be over, and the organism in great part have settled down on the bottom and sides of the tube in fine particulate sand-like masses, leaving the culture medium almost perfectly clear.

The natural habitat of the bacillus appears to be the mucous surfaces of the fourth or true stomach of the sheep and the intestine, and there the bacilli are found in infected animals in enormous numbers.

SYMPTOMS OF BRAXY.- As a rule, in the field very little can be said on that head owing to the fact that the affected animal dies so rapidly, and not infrequently the first intimation that braxy is present is the finding of a sheep dead, and the carcass very much distended with gas. This is frequently what the shepherd sees in going round his flock in the early morning, and almost invariably it is one of the fattest hoggs that is the victim. The symptoms when noticed are, first, a short quick step, a cessation of feeding, restlessness and uneasiness, with a tendency to lie down and get up suddenly. Latterly there is a separation from the rest of the flock, a more or less dazed appearance, and a disinclination to rise when disturbed, followed latterly by an inability to do so, and soon thereafter death supervenes.

A few hours before death the temperature rises—105° to 108° F., the breathing becomes laboured, the head depressed, and frequently the belly becomes tympanitic. If this latter condition does not precede death it invariably rapidly follows it, and within a couple of hours is very marked indeed.

POST-MORTEM APPEARANCES OF BRAXY.—One of the most noticeable features is the early putrefaction of the carcass. From the Report of the Braxy Committee it appears that this is caused not by the ordinary organisms of putrefaction, as is usually the case, but by the braxy bacillus. In fact, even after putrefaction is very far advanced these organisms are conspicuous by their absence, and the ordinary liquids of the body fairly teem with the braxy bacilli, which can be found in the peritoneal liquid in almost pure culture even days after the death of the animal.

On opening the abdomen the first three stomachs are found to be distended with fodder, whilst the fourth or true digestive stomach is empty, or contains only a little brownish-coloured liquid consisting of blood-stained mucus, which when examined microscopically is found to be teeming with the specific bacilli. The veins on the surface of the fourth stomach are distended and exude colouring matter from the blood, which, after death, stains the organ a vivid crimson, and this is frequently mistaken for acute inflammation. Latterly, as putrefaction advances, the colour changes to a livid green, and occasionally on parts there is noticed congestion, abrasion, or ulceration, and sometimes gangrenous sloughs.

In the intestine a condition of catarrh exists, and a scraping of this examined microscopically reveals the specific bacillus present in enormous numbers mixed up with shed epithelium. Even when braxy is produced experimentally by subcutaneous inoculation the intestine will be found swarming with the organism, clearly indicating that the intestine and its contents afford peculiar facilities for its propagation

Treatment.—There is no known curative treatment in well-marked cases Many methods have been tried, but with invariable want of success, and among flock owners it has come to be looked upon as one of the ills of sheep-farming that must be endured.

Prevention.—Preventive measures, when these can be satisfactorily adopted, meet with a modicum of success, but until recently they were impracticable except to a few specially favoured individuals, and were of little or no avail on infected farms. They consisted in sending away the young stock from the infected farms to winter in other parts where the disease did not occur, and bringing them back in the spring to the original farm at the time when the disease is naturally sparingly present or altogether absent By this method the fatalities were very much reduced, but the cost was, and is, a very considerable item Recently, however, from the researches of the Braxy and Louping-Ill Committee, and as the result of numerous experiments conducted in connection therewith, a method of preventive treatment was evolved which, although at present in the experimental stage, promises to be of very considerable value, and does away with the necessity of removing the young stock

It was led up to in rather a remarkable manner, and was hit upon when experimenting with the various methods of growing the specific organism of the disease. Amongst the various culture media employed for this purpose, Professor Hamilton made some interesting experiments with the blood serum of healthy sheep, which sheep had been slaughtered for food purposes In repeating these at various periods of the year, certain anomalies in the growth of the bacilli in the serum occurred In some instances they reproduced themselves with great rapidity and regularity, but in other instances they did not grow at all; and even when a culture rich in bacilli was added in considerable quantity, not only did growth *not* take place, but the living bacilli which were introduced into the serum flask completely disappeared. Continuing the experiments he found that the irregularity of growth depended on the period of the year at which the blood serum was obtained. In the late autumn and winter months the growth was profuse, but in the other months it was slight or altogether suppressed. It was further noticed that this suppression of growth and destruction of the bacilli was found to be at its highest in the months of July and August; and bearing in mind that braxy was a disease which as a rule only occurred naturally in the months from November to January, and that it was in blood serum obtained in these months that the growth of the bacilli occurred in the greatest profusion, he concluded that this was probably the reason for the seasonal character of the disease; and that if it were possible to dose the young stock with a culture of the bacilli by the mouth at the time when their blood was destructive to the organisms a certain amount of immunity might in this way be obtained; or, in other words, that the sheep would pass through a mild attack of the malady which would in all probability strengthen their systems against the natural attack of the disease at the later and dangerous period of the year.

Working on this assumption, up to the present time some thousands of young sheep have been so treated, and the result has been so far of a very satisfactory nature. In fact, although the sheep have been wintered in badly infected fields, the mortality, so far, from genuine braxy among them, has been infinitesimal; and if a continuation of these experiments gives the same results, then in all probability we have a means at hand which will be of incalculable benefit to the sheep-farmers struggling against this fell disease.

The method adopted for the last three or four years consists in the administration of a culture of the braxy bacillus by the mouth during the month of August. This is found to be free from danger, and is so effectual that any mortality is hardly worth considering. It may be mentioned that with the view of continuing this treatment and further testing its efficacy, the necessary materials can be obtained at a nominal cost on application to the Secretary of the Braxy and Louping-Ill Committee, Marischal College, Aberdeen [J. M'C]

Brazil Nut. The Brazil Nut tree (*Bertholletia excelsa*, H and Bonpl) is widely distributed over Guiana, Venezuela, and Brazil. On the banks of the Orinoco, Amazon, and Rio Negro it forms huge forests which prove a source of great profit to the natives The tree grows to a height of 100 to 150 ft , and has a diameter of 3 to 4 ft. The stem, to within 20 to 30 ft of its apex, is almost branchless, but at this point the branch system commences, bearing large bright-green leaves. The tree sheds its leaves annually, though it is never really leafless It could with advantage be grown as an ornamental tree. The fruit is nearly round, about 6 in. in diameter, and provided with a woody shell ½ in thick. Each fruit contains about twenty-four of the hard-shelled seeds which are marketed as nuts. On ripening, the fruit drops from the tree, and is collected by the native Indians, who afterwards break up the outer shell, extract the nuts, and, in the case of Brazil, take them by canoe to Pará Pará is the chief port from which Brazil nuts are exported, and 40,000 to 60,000 hectolitres are shipped annually to North American and European countries. In addition to forming a favourite article of dessert, Brazil nuts act as the source of a light oil which is largely used by artists and watchmakers. The nuts contain 50 to 60 per cent of oil, and 12 to 15 per cent of albuminous matter, but their close texture renders them very indigestible, and prevents their being largely used as a food supply. [H. W.]

Bread, Chemistry of.—The term 'bread' may be applied to any loaf or cake made by baking any ground cereal, and so it includes such well-known articles as oatcakes and barley scones, as well as the ordinary wheaten loaves. In the majority of cases, however, it is applied to loaves made by baking wheaten flour, and that is the limitation put upon the term in the following paragraphs

The simplest form of bread is exhibited in the 'damper' of Australia and the 'chapati' of India; it consists merely of flour and water mixed into a dough and baked as a flat cake or scone. The chemistry of such bread necessarily depends upon that of the original flour; the only changes in the process of baking are the conversion of some of the starch into dextrin, and the trifling loss of some of the vegetable fats by overheating, in fact, the composition of such cakes is similar to that of water biscuit.

In a more limited sense the term 'bread' is applied to a dough which has been aerated by some gas, usually carbon dioxide (CO_2), with or without the help of other volatile products, such as alcohol and water vapour.

The action of the gas is purely mechanical, separating the particles of dough so as to produce a porous 'crumb', owing to the high temperature employed in baking, no traces of these gases are found in the loaf. There are three methods of producing this effect. (1) by mechanical means; (2) by chemical means; and (3) by vital action or fermentation; and it is to the results of this last process that the name 'bread' is most restricted

In Dauglish's process, bread is 'aerated' by forcing carbon dioxide through the dough under pressure. For 280 lb of flour about 20 cu ft of the gas are required, and of this quantity about 11 cu. ft. are actually incorporated with the flour. Such aerated bread is sweeter than ordinary bread; it is drier, and therefore does not mould readily, but crumbles, being very brittle, its flavour differs appreciably from that of ordinary bread, and is due to the absence of by-products due to fermentation. As these last are not only flavouring materials but actually digestive products, aerated bread is less digestible than the ordinary.

The chemical processes used for producing carbon dioxide within the dough are chiefly used for small articles and only in domestic baking. Practically they all depend upon sodium bicarbonate or baking soda, from which the carbon dioxide required is liberated by either an acid or an acid salt. Necessarily, unless the proportions of the combining substances are properly adjusted, an excess of either one or other remains in the bread, and in any case there is the formation of a neutral salt as the result of their proper combination. A common combination is baking soda and cream of tartar. Now baking soda is sodium bicarbonate ($NaHCO_3$), and cream of tartar is potassium bitartrate ($KH\bar{T}$), and the result of their combination in proper proportions is carbon dioxide (CO_2), which aerates the bread, and water vapour, and potassium sodium tartrate or Rochelle salt ($NaK\bar{T}$), which remains in the bread. The chemical equation is:

$$NaHCO_3 + KHT = NaK\bar{T} + H_2O + CO_2.$$

If tartaric acid is used instead of cream of tartar, the residual salt is sodium tartrate; with buttermilk, sodium lactate is formed, due to the lactic acid in milk; with hydrochloric acid, common salt is formed; and so on. The baking powders of commerce are all such chemical mixtures, generally toned down by rice flour so as to delay the chemical action.

M'Dougall in America and Liebig in Germany suggested acid phosphate of lime as the acid substance, this in combination with baking soda would give a phosphate of lime and potash as the residual salt, and so increase the phosphorus income of the body. As, however, phosphates are already fully oxidized, feeding a man on phosphates is like feeding a fire with ashes.

In Neville's process, ammonium carbonate is used without any baking soda. Under the action of heat this substance decomposes into ammonia and carbon dioxide, both of which are available for aerating purposes, and are expelled by heat, leaving no residue whatever.

Practically, all the commercial bread is produced by fermentation, among primitive peoples by leaven, in civilized communities by yeast Leaven as used to this day in the country districts of France and Switzerland is made by saving a little of the dough used in baking, mixing it with flour and water added in several portions, and then allowing it to stand so as to encourage fermentation The result is that in addition to yeast cells there are produced fair quantities of lactic and butyric bacteria, which give the bread a much more acid taste than that made from yeast alone. The crumb of such bread has large, irregular cavities, due to the fact that the bacteria in the leaven give rise to a ferment (diastase) and acids, which tend to soften the gluten. Boutroux considers leavened bread more healthful than yeast bread, because the acids it contains help digestion.

The Scotch use of 'barm' is somewhat similar. Barm is the foamy scum which forms on the top when beer is made, and consists practically of yeast with admixture of other bacteria from the air. For details of this process, which is almost universal in Scotland and very economical, see Jago's Science and Art of Bread-making, London, 1895. Like bread made from leaven, this bread is more acid than ordinary.

The London system, now very generally followed, presents many interesting points of chemistry It consists of three stages, lasting over twelve hours: (1) the preparation of the 'ferment'; (2) the preparation of the 'sponge'; (3) the preparation of the 'dough'.

The 'ferment' consists of a mixture of potatoes, flour, and yeast in water at 30° C. (86° F.), and as the result of this stage, which lasts five hours, the yeast becomes very active, decomposing the starch of both potatoes and flour, forming maltose and dextrin, and decomposing the proteids of the flour into substances resembling peptone, thus to a certain extent 'digesting' the flour. This actively fermenting mass is now added to flour and water to form the 'sponge', salt being added to slow down the fermentation. In about five hours the 'sponge' rises and breaks, showing that carbon dioxide is now being formed from the maltose and dextrin of the first stage, alcohol in rather greater proportion (23 : 22) being retained in the mass. In the third stage the rest of the water and flour are added, fermentation is continued for an hour, and the mass is then fired for an hour and a half in an oven at 204° to 232° C (400° to 450° F.), though the temperature of the actual dough is not much above 100° C. (212° F.). The high temperature arrests further fermentation, kills the yeast, dispels all the carbon dioxide and alcohol and a good deal of the water, thus promoting aeration, and so allowing the heat to penetrate to the interior; finally, it develops the peculiar aroma and flavour of the bread, producing small quantities of acetic and lactic acids from alcohol and sugar respectively, converting nearly all the starch and sugars of the crust into dextrin and caramels, and otherwise forming aromatic bodies at the expense of the nitrogenous constituents of the crust, especially if the bread is overfired

The changes from flour into bread are indicated by the following analyses, which may be taken as typical:—

	Water	Proteids	Fat	Carbohydrates	Ash.
Flour	12·0	11·4	1·0	75·1	0·5
Bread, average	35·3	9·2	1·3	53·1	1·1

The increase in water evidently comes from the water used to form dough; and the similar increase in fat and ash is due to the use of butter or lard and salt The proteid and carbohydrate loss is explained by the fact that they went to nourish the yeast, and have been expelled as alcohol and carbon dioxide Part of the starch in the crust has been converted into dextrin; that in the crumb has been cooked by the vapours, becoming gelatinous or partly soluble; the gluten has been coagulated much as white of egg does in boiling;—in short, the bread is to a certain extent pre-digested

ANALYSES FROM AMERICAN SOURCES FOR COMPARISON

	Water.	Proteids	Fat	Carbohydrates	Ash
Corn (*i.e.* Maize) bread (Johnny cake)	38·9	7·9	4·7	46·3	2·2
Rye bread	35·7	9·0	0·6	53·2	1·5
Rye and wheat bread	35·3	11·9	0·3	51·5	1·0
Wheat bread, ‘Gluten’	38·2	9·3	1·4	49·8	1·3
,, ‘Graham’	35·7	8·9	1·8	52·1	1·5
,, ‘Rolls’	29·2	8·9	4·1	56·7	1·1
,, high-grade patent flour	32·9	8·7	1·1	56·5	0·5
,, regular ,,	34·1	9·0	1·3	54·9	0·7
,, bakers' flour	39·1	10·6	1·2	48·3	0·9
,, low-grade flour	40·7	12·6	1·1	44·3	1·3
Whole wheat bread	38·4	9·7	0·9	49·7	1·3
Crackers (*i.e.* Biscuits)	6·8	10·7	8·8	71·9	1·8

The chemical examination of bread under the Food and Drugs Act demands an estimation of water and acidity, and the search for adulterants, chiefly alum, used for whitening purposes. For details of these processes see Notter and Firth, Theory and Practice of Hygiene, ch iv, ‘Examination of Bread’, Stevenson and Murphy's Treatise on Hygiene, vol. i, pp 461–4, or any standard text-book on Food Analysis, such as that of Winter Blyth. The most recent work in the chemistry, digestibility, and nutritive value of bread has been done by the Department of Agriculture, U.S.A , and students are referred more particularly to Bulletins 67, 85, 101 of that Department, as well as to Farmers' Bulletin No. 112. [J. K]

Bread Corn.—This term includes all kinds of grain which are used as the staple of bread. The principal bread corn of cold climates is barley, oats, and rye; of temperate climates, wheat and maize; and of hot climates, rice. In Scotland, cakes or bannocks made of oatmeal formerly constituted an almost universal article of diet. Rye is still to a considerable extent the bread corn of Germany, Norway, and Sweden, and the more northern parts of Russia. Wheat is, however, gradually displacing all other varieties of grain as the cereal food of man. [J. B.]

Break, a term applied to land which is ploughed for the first time after it has lain for two or more years in grass This is sometimes termed the ‘lea’ break, in contradistinction to the land which is ploughed out of stubble, and which is known as the stubble, green crop, or turnip break The term ‘break’ is also used in a more restricted sense than the above to denote the first operation in ploughing. See PLOUGHING.

Break-furrowing. — This consists in ploughing out alternate furrow slices and turning them over on the surface of the unturned slices It used to be practised on light stubble land, the method of ploughing being known as ‘ribbing’. It is practically the same thing on stubble land as ‘raftering’ is on grass land. See arts RIBBING and RAFTERING.

Breaking.— The education of the horse to the various purposes for which he is required is spoken of as breaking; the breaking of his will to ours, so that he knows no other will when he has learned his business. The sooner his education is commenced the better; but long vacations are consistent with the best of schooling, provided only that the lessons have been properly learned. To make our meaning clearer, we may point to the desirability of controlling the foal when only a few days old—while yet a strong man is stronger than he, and can hold and place a halter upon his head, and compel him to submit to its restraint. The halter should be turned once round a post or rail, while the free end remains in the hands of the man, who will thus save himself the strain when the foal struggles to get away, but will be able to give and take—a very much safer plan than having a fixed point, since some passionate youngsters may injure themselves before being fully convinced of the uselessness of resistance When fatigued to the point of yielding, the opportunity should be taken of 'gentling' the animal all over; teaching him, that is to say, to be handled—holding up a foot—passing the hand over his head—along his back—down his hind legs as well as fore ones. Before releasing him, he must be made to feel his entire helplessness in the hands of man, and when let go, the removal of the halter must be effected in a quiet manner, the man walking away from him, to avoid the mistake on the colt's part of supposing that he has obtained his own liberty by any adroit movement. Foals thus handled are never likely to learn their own strength, and a moral victory has been won. If a foal has to be shown, or taken to a fair or market, this early lesson will save most of the trouble and nearly all the risk attendant on such exhibitions, the animal being easily led, and perhaps securing a prize over the head of an equally good animal which gives the judges more trouble to examine If he is ever ill, he will be more easily medicated. If castration has to be performed, he will not be overheated in a fight to first secure him.

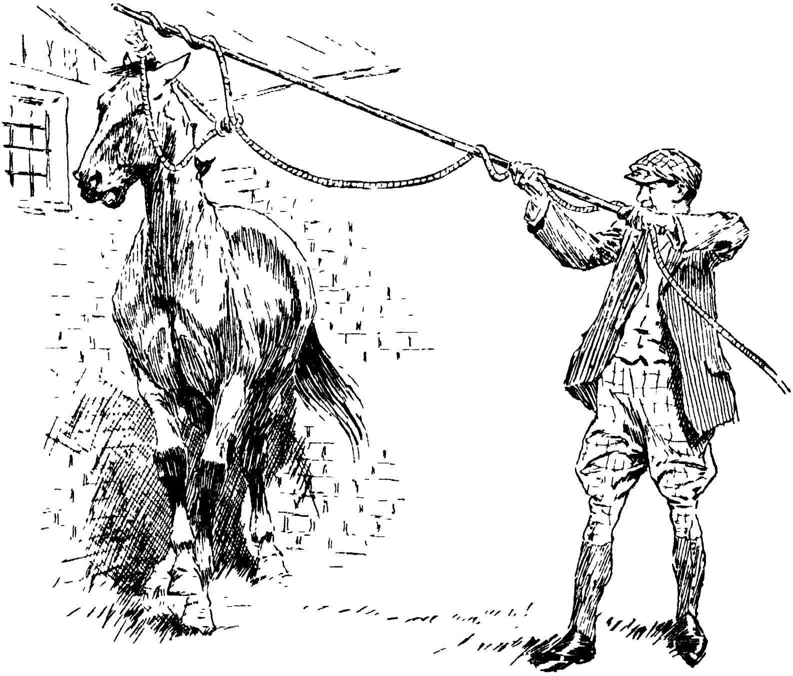


Fig 1 —Placing Halter on Colt's Head

The yearling that has not been so handled, or the two-year-old brought up for breaking, will be got into a building, and a halter put on him after many attempts. The usual plan is to attach the halter to a 10-foot pole of light weight, which is first gently placed upon him at different points, and lightly rubbed, in a manner calculated to assure him that it won't hurt him in any way. By degrees he allows the halter to be pulled down over his head; meanwhile leaning against the wall, taught by instinct to offer the most suitable form of resistance. The loop through which the halter runs is then quietly knotted, so that it shall not draw tight when he attempts to get away, yet securely hold him. The tag or rope-end of the halter is twice the length of an ordinary one, or two are tied end to end to afford enough hold for two or three men. By pulling him round in a half circle much of his strength is wasted and that of the men conserved. By pulling him sideways he is thrown off his balance. A dead pull in a straight line forward will not succeed, as his strength is great, and he knows intuitively how to set his legs and offer the greatest resistance. The lesson should be short; the temper not unnecessarily tried, but victory must always remain with the breaker. After a few such lessons the colt may be taken into a field, and a front leg strapped up while the surcingle is put on, not too tight the first time. A dumb-jockey may be put on to accustom him to its feeling and appearance. A little leading and turning will be enough. Then in the stable, the leather head-collar will replace the hempen halter, and to this will be attached what is known as a key bit, which is a bar bit with a number of pieces strung upon it, and which lie upon his tongue. The champing of this bit occupies his attention, while accustoming him to the presence of a bar of some kind in his mouth. The reins of the dumb-jockey may then be attached, and the colt secured to the pillars of a stall; but he should not be left alone the first time or two, or until his manner is submissive. Next he may be taught the meaning of the long reins and of the crupper. The reins are passed through rings in the surcingle and attached to the bit, the breaker taking up a position behind, where he can flap them against the flanks and about the hind quarters, until the pupil ceases to be alarmed by their contact. This will be enough for one day, and the colt should be taken back to the stable and made to understand by the tone of voice and manner of the breaker that he has done well. It is a great mistake to force too many lessons on the young animal in a short time; besides which, the degree of intelligence varies greatly in colts, and tempers may be spoiled which would be fairly good if sufficient patience were taken with dullards. Another day, with kneecaps as a safeguard, the pupil may be driven with long reins in a figure of eight; reversing the turns, and insisting on implicit obedience. This driving with long reins and at a walk should be persistently practised, in order to give a good 'mouth' to a harness horse. He should learn to respond to the mere weight of one rein being a little greater than the other by reason of more being let out, or a wave-like motion imparted to it by the hand. The least soreness of the angles of the mouth should be the sign for a holiday, because soreness is followed by hardness, and hardness by insensibility. In this way so-called hard mouths and one-sided mouths are made, while every good horseman deems a light or sensitive mouth a recommendation; more especially is the saddle horse desired to have a light responsive mouth. In this connection it may be necessary to refer to the fatuous practice of ignorant breakers who, with a hard-mouthed or wilful animal to deal with, think to cure him by blistering or applying irritants to the corners of the mouth. The pain caused by the pressure of the bit may render the poor beast obedient for the time, but the inevitable result is the permanent hardening and insensibility alluded to above.

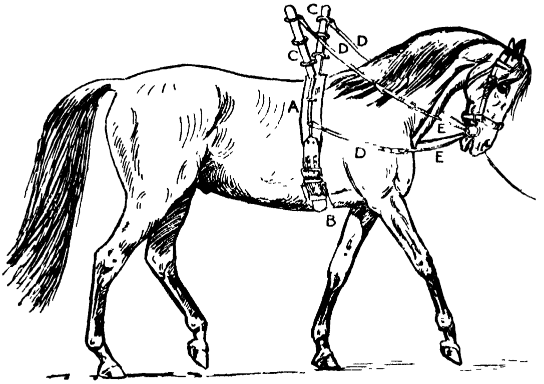


Fig 2 – Dumb Jockey

A, Saddle, B, girth strap, C, wooden cross-trees, D, elastic cords, E, leather reins passing through the bit-rings

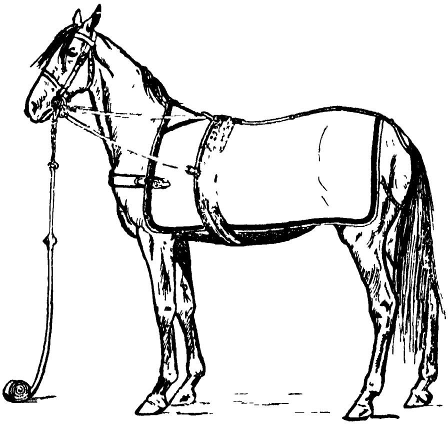


Fig 3 – Surcingle

When the colt readily responds to every action desired of him in long reins, he may be put in shafts for the first time, or alongside a pole with an old stager. Breakers as a rule prefer double harness first, but some rogues of horses will trot along very merrily, while the other horse does all the work, and they are not pulling a pound. When subsequently put into single harness, they are more disposed to jib or refuse than colts that have never been in double harness. The system advocated by Mr. William Barker of Shillelagh is a good one, and consists in a pair of 'safety shafts' without a body or wheels, by which the colt becomes accustomed to the poles alongside him, which are attached as they will presently be when he is harnessed to a cart. The breaker should be a man of patience and enamoured of his work; then he learns how far his pupil understands him, and to what degree he is willing to comply, and so he will from this point make much difference in his procedure with animals varying in temper and capacity. As a rule, the colt that has been schooled to long reins, and yielded obedience during the last few lessons, will be fit to put between shafts. At least three men should be concerned in putting him in. If the 'tugs' are of the usual kind, great care must be exercised in running the shafts through them. So-called French or Tilbury 'tugs' are useful for breaking, as the straps lap round the shafts, and are not necessarily operated on both sides at the same moment. A colt should not be expected to step over or back into the space between shafts on the ground, but the latter should be held high and quietly lowered into position when the pupil is standing correctly. Any bungling at this crisis in the horse's education is apt to leave permanent trouble. If the shafts drop and startle him, or if with his blinkers on he gets 'mixed' in the shafts, crossing and recrossing will follow before he can be got to back into the correct position. Many horses continue all their lives to give trouble in this respect, and a light horse will require two men to put him to, when one can manage by himself with a steady animal. A quiet manner and absence of all excitement and fuss is best calculated to give a good start in harness. The traces are hooked on; the double kicking strap or extra halter placed well back to be of any use, a hemp halter under the harness bridle, with the tag free, is to be held by one man, while another on the off side is ready for contingencies. When the driver has taken his place and given the signal to start on a nice level piece of road, the man on the near side may chirrup to the colt and give the slightest bit of a lead, and if the animal goes straight, he keeps pace alongside, looking to the driver for instructions. At the first bend in the road a little help to the shafts will be given by the men on foot: perhaps a push from the side, or pull on the point of the shaft in turning a corner, reversing the action when turning about or going to the opposite side. If the general adjustment of the harness is right, the colt soon learns to carry the cart round with a swing, so that one shaft does not press against the collar, or get under it, as happens when the traces are too long. When level going at a walk and slow trot has been satisfactorily performed, the crucial test of up hill and down dale sets the seal on the animal's character. He should not be put to a stiff hill at once, but learn to pull up a moderate incline with only a light weight, then steeper and with greater loads by degrees, until his hardened shoulders feel no discomfort when exerting himself to his utmost. In going downhill, the proof will come of the use of the breeching during the long reins practice. The young horse should not feel the cart running on him, and be taken by surprise by a load which threatens to push him over, and from which he may bolt and his character be ruined. The slope should be a gradual one, and the animal be stopped from time to time and slightly backed into his breeching, until he really sustains considerable weight. All this takes time, but it is time well spent when a sound elementary education is obtained. The finishing usually devolves upon the dealer, and the 'manners' imparted by such experts do not belong strictly to our subject of breaking.

Heavy horses, as those intended for the general work of the farm, are usually taken in hand towards the end of their second year, and soon begin to contribute to their own maintenance. The 'gentling' previously advised refers equally to these animals, who should be early made to obey. The custom, when first put to work, of placing the colt in the middle of a team is generally satisfactory. The chain harness and gear prevent him from going far wrong when an old stager is in front and rear, and if he doesn't at first put weight in the collar, he soon learns to do so with a little judicious urging from the teamster at his side. The chains at his sides and the spreader behind make it easy for him to understand the shafts and breeching when put into a cart or wagon, but he is not made to haul alone until his behaviour in chains is such as to guarantee that he will not prove 'collar proud' in a more responsible position. General handiness may be expected to follow, but very much depends upon the carter, and young horses should never be put in the hands of bad-tempered or incompetent men, or they may be spoiled after the breaker has done his part.

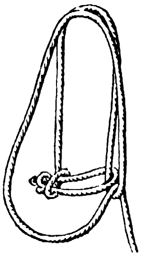


Fig 4.—Pratt's Twitch

Breaking to saddle or breaking for riding purposes is in some respects a more arduous and delicate task than breaking to harness. It requires a closer understanding, which is not inaptly termed sympathy, between rider and ridden. The well-mannered hack is a much valued animal, and the temperate hunter commands a high price, while the chaser and racehorse fetch fabulous sums when capable of winning either of the kinds of races for which they are specially trained. The importance of a good mouth has already been insisted upon in speaking of breaking to harness; how much more necessary and desirable is it in the case of the animal upon which one is seated, and whose failure to respond to the slightest intimation of the rider may bring both to grief! The riding horse must stand still to be mounted, and wait for the word of command, the pressure of the knee or touch of the bridle must convey to him all that the rider wishes him to understand. He must lead with either leg, or change them when stroked upon the shoulder; change his paces, halt, stand, turn back, or pass sideways, when the voice, the hand, or the heel give him orders to do so. He must stand at a gate while the rider unfastens it, or collect himself for a jump if required, with a fine estimation of pace and distance and impetus before taking off, and be 'clever' at landing; while all the time yielding absolute obedience to a superior will. The noise of wheels and the greater distance from the animal preclude that intercourse between the man and horse, when driving, which is so valuable when carried on by the voice of a rider and understood by his mount. Many Irish horses, to whom their breakers talk as other folks do to pet dogs, are so easily commanded by the tone in which words are expressed, that it is literally true that they could be 'ridden with a pack thread', but these same horses, with a heavy-handed, unskilled man upon them, would prove ungovernable in the hunting-field. The first steps towards breaking for saddle are the same as those for harness, and consist in obtaining control over the animal and submission of his will to the breakers.

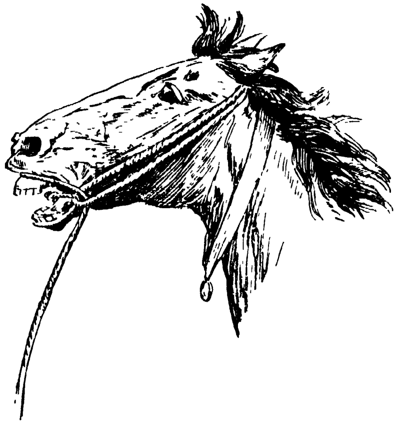


Fig. 5.—Twitch applied

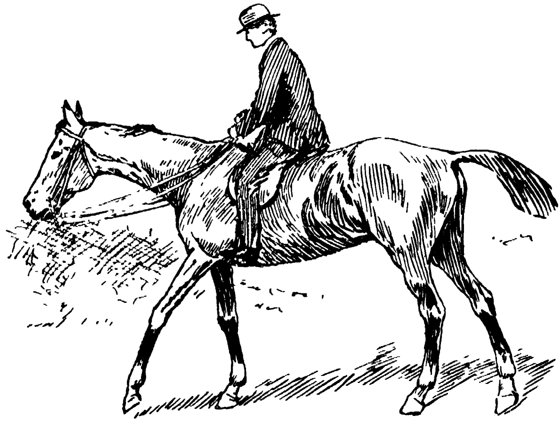


Fig. 6.—Tired Horse with Outstretched Neck (swinging his head)

Except a colt shows a disinclination to obey orders, the making and training of him depend chiefly upon the possession of light hands, patience, good temper, and firmness with the pupil. The preliminary training or discipline having succeeded, the colt must be accustomed to saddling and girthing up; the latter often proving trying to his temper, as the girths must be pulled tight, because they so easily slack out when exercise has reduced the volume of the trunk. Upon the saddle we place a weight—a sack half-full of corn, for example—and if he shows signs of fear he must be assured by kindly tones of its harmlessness. If perverse he must be corrected by the rope-twitch which some breakers will have placed on him in readiness. With this deadweight upon him, he is circled and turned and reined back by the long reins in the hands of the man on foot, until he is quite steady and accustomed to its presence. To mount him is the next thing, the breaker quietly rising in the stirrup and seating himself; dismounting again, and repeating this drill several times, before attempting to ride him. Some breakers place their assistant upon the colt without reins, while guiding the pupil themselves with the long reins to which the animal has already been accustomed. Others give him bridle reins, with instructions to avoid using them until presently the long reins are removed. The rider has then to make the animal familiar with the feeling of a man on his back, and cause him to walk away in a straight line, in obedience to the voice and pressure of the knee and boot heel. The rider will have his reins gathered and the bit gently felt by the horse, having equal pressure at both sides of the mouth. The pressure must not be enough to check his forward movements, but simply to keep him collected or at attention; any disposition to stop being checked by word and heel. He will presently require the colt to make wide circles, first in one direction and then in another. Standing up in the stirrups, and in one stirrup at a time, while in motion and at rest must be practised. No lesson should be prolonged beyond forty or fifty minutes, and a good breaker will often give less to a horse of doubtful temper if he obeys.

A sulky colt is more likely to show temper when beginning to feel fatigue, and should not have it too much tried. The inexperienced breaker is apt to forget that 'soft' colts are quickly tired, as may be seen by the facility with which they 'lather' or break out into a sweat, and it is better that they should have short turns often repeated, and not develop faults needing correction in the way of punishment.

The whip should not be an instrument of fear or punishment alone, although it may have to be so employed. In learning to make short turns, for instance, the whip is lightly touched against the quarter of the side to which the animal is required to move, while the rein of that side co-operates. At the walk it is natural for a horse to use his head and neck as a balancing pole, and the rider allows more rein, and takes but a light 'feel' of the mouth. At the trot, a raised head and nearly immovable state of the neck affords the best balance, and the rider will keep a steady hold of the reins and keep his hands higher than if the animal were walking. It is said that one should ride more by the legs than by the hands, and by this it is intended that the breaker should use his own heels to stimulate the animal to bring his hind legs forward It is the hind limbs which chiefly propel a horse, and if taught to carry them well forward, while speed is checked by the reins, the weight of the rider upon the forehand is materially reduced By such means the saddle horse is made to go in a collected manner, and the stimulus behind, and restraint in front, cause him to arch his neck, bend his knees, and flex his hocks in the best manner. The man who merely makes sure of his own safety, and cannot give his attention to the development of the animal's paces, is quite unfit to ride a colt, and should delegate the work to another. The canter is one of three time, and an artificial one—very easy to the rider, but tiring to the horse. To ease the horse, the breaker makes him change the leading fore leg. This should never be attempted while turning, as crossing the legs and a fall may result The leading leg will be the one whose shoulder is most forward, and from which it is most easy for the horse to break into a canter If slightly inclined to the other side by the rein, and the shoulder stroked with the whip, he will change the leading leg, and so ease his muscles. The rider alters his position to correct balance A backward position in the saddle is favourable to both horse and rider. The canter is a favourite pace with ladies, and hacks intended for their use are specially schooled in this pace. The walk and the gallop are the only paces of the wild horse. Trotting, cantering, and ambling are more or less hereditary in domesticated horses, but perfection of action is not so easily acquired. Horses are taught to jump over low obstacles while controlled by the long reins, the height and width of the jumps being increased until the pupil constantly negotiates them satisfactorily. Then he is made to carry a light man over the lesser obstacles first, thus acquiring by degrees the knowledge of how to support a weight and maintain balance—a matter in which the rider greatly contributes by his own conduct in the saddle. When rising to a jump, the man leans forwards, not merely to maintain his equilibrium, but to throw his weight upon the hind limbs of the animal, which are resting upon the ground. As the animal comes down on the opposite side, the man leans back, maintaining his own balance and relieving the fore quarter of the animal of as much weight as possible. In landing over a jump, the weight is for the fraction of a second sustained by one fore leg only. The various paces of the horse have formed the subject matter of large volumes, and been condensed into interesting form by Captain Hayes in his Points of the Horse. The reader is also referred to Illustrated Horse-breaking, by the same author, who deals very fully with the methods of correcting the faults which arise in the course of

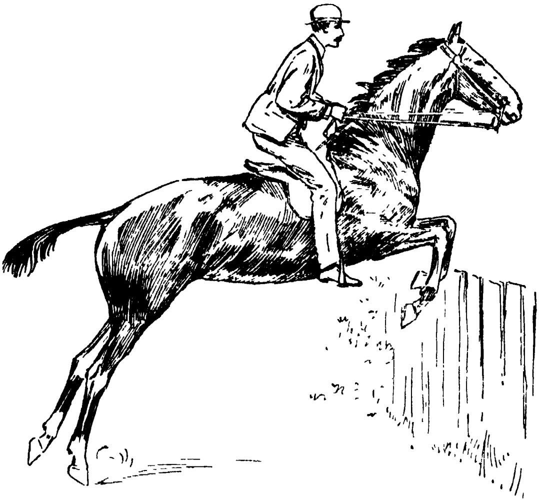


Fig 7 Horse Rising to a Jump, Rider Leaning Forward

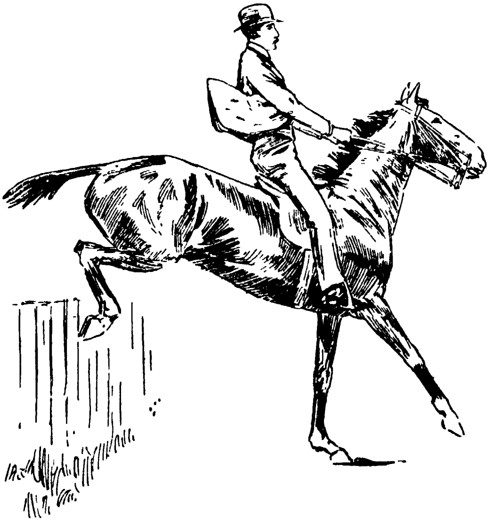


Fig 8 - Horse Landing from a Jump, Rider Leaning Back

a breaker's work, and are somewhat outside the intention of this article. [H. L.]

Breast Plough. See Ploughs.

Breast Wheel. See Water Wheels.

Breeching, that part of harness which passes around the horse's breech. It is attached to the shafts or chains, and enables the animal to back a load, or prevent the vehicle to which he is attached from overtaking him when going downhill. [H. L.]

Breed, a distinctive group of animals which has arisen under human control or selection. The idea behind the word—which is often used very loosely—is that man has acted as a breeder, that he has interfered to some extent with the natural possibilities of pairing or mating, *e.g.* by restricting the range of crossing, by pairing similar forms together, or by securing some measure of isolation from natural conditions. The term is best applied to the result of a humanly controlled splitting up of a species or of a domesticated race. We cannot rigidly restrict it to domesticated animals, for the experimental evolutionist may produce 'breeds' of animals, such as beetles, which no one would call 'domesticated'. On the other hand, there is no utility in distinguishing, as Darwin did, between 'artificial breeds' and 'natural breeds', for the latter term is simply equivalent to a variety or sub-species arising in natural conditions. In fact, a 'natural breed' is a contradiction in terms. When man has succeeded in 'domesticating' the descendants of a wild species (or of several nearly related wild species), so that there results a fertile domesticated race, more or less under his control, he may proceed to split up this 'race' into 'breeds'. Thus the race of domesticated pigeons has been split up into many 'breeds' and 'sub-breeds', and similarly for rabbits, ducks, fowls, and so too for the more difficult cases of dogs, horses, cattle, sheep, and so on For practical purposes, a 'breed' means a subdivision of a domesticated 'race'. Thus we speak of the Polled Angus breed of cattle the Clydesdale breed of horses, the Cheviot breed of sheep, the Skye Terrier breed of dogs, the Fantail breed of pigeons, and so on through the long list. The descendants of the black cattle that occurred in Britain before the Romans came are represented nowadays by Aberdeen-Angus, Galloways, Welsh, Kerries, &c., and we say that these *breeds* have come out of the black *race*.

The origin of a breed is always preceded by the occurrence of certain germinal or inborn or constitutional variations. How this 'raw material of evolution' is forthcoming we do not know. It may be that the germ cells are prompted to change by the inevitable oscillations—especially in the vascular fluids—of the body that bears them; it may be that the intricate processes which occur in the germ cells before, during, and after fertilization bring about new permutations and combinations of the mosaic of elements which make up the inheritance; it may be that the germ cells have an inherent power of varying, as fundamental and as far beyond our present possibilities of interpretation as their power of growth and development is; but our ignorance of the conditions of variations is, as Darwin said, immense. What there is no doubt about is that inborn variations, expressing themselves as deviations from the parental type or from the mean of the ancestral stock, do occur very frequently. We can measure them and, what is equally important, we can utilize them. They may be minute fluctuations, or they may be 'discontinuous variations' of considerable amount; they may mean a little more or a little less of a character which the parents or one of the parents exhibited, or they may be unexpected and novel; they may tend in the direction of health or in the direction of disease; they may be progressive or retrogressive; they may be transient in succeeding generations or they may come to stay.

Given a number (even one[1]) of these variants, that is to say, individuals with a well-defined inborn variation—not, of course, a merely superficial 'modification' directly induced from without or by feeding, for that sort of thing is of little moment—the breeder has got his 'raw material' for breeding. If the variation is one which seems likely to be profitable, or which strikes his fancy, he proceeds to breed from it His success will depend partly on the nature of the variation, for it may go as mysteriously as it came, partly on his own carefulness in breeding If we may generalize the usual mode of procedure, the breeder must secure a certain degree of reproductive isolation for the new variants, he must breed similar forms or the most likely forms together; he must eliminate from their progeny those forms which do not conform to the pattern he is aiming at; he must in-breed the desirable forms closely to promote prepotency or staying power in inheritance; he must make the most of any particularly prepotent sire or dam that results from his selective breeding, so that the good qualities of that parent may saturate his growing herd; and thus by patient, consistent, and resolute adherence to a regime of isolation, elimination, and selective pairing, he may succeed in establishing a stable breed. In all cases, however, he can deal only with what is provided by the mysterious fountain of change within the germ cells, for in spite of popular impressions, it is variation that leads, the breeder can only follow—and select. It seems likely that the progress which is now being made with experimental breeding on many different kinds of living creatures will lead to a more definite knowledge of the laws of heredity, which will render the making of 'breeds' at once more intelligible and less uncertain See next article, also Animals, Domestication of, Evolution, Heredity, Species, Variation. [J. A. T.]

Breeding, Laws of.—By the laws of breeding are meant the rules or principles by which the operations of animal and plant breeders are regulated. This being the case, an article on the laws of breeding should mainly consist of an enumeration of the rules to be observed by breeders. But as the breeding of plants and animals has not yet been reduced to an exact science, it will only be possible to indicate how breeds have been formed in the past, and on what lines breeders may best work in the future.

During the early Stone Age there were apparently neither plants nor animals living under domestication in Europe, and even at the beginning of the Bronze Age there were few domestic animals and a relatively small number of cultivated plants. Since the Iron Age there has been a great increase in the number of plants under cultivation, but though many animals have been tamed since Neolithic times the number of species living under domestication is still very small. This is doubtless owing to the fact that animals with rare exceptions are either not adapted for living under domestication or they are incapable of ministering to the wants of man. The smallness in the number of domesticated species has, however, been to a large extent made up for by the creation of numerous breeds and strains of those originally selected. Evidence of this we have in the annual exhibitions held by agricultural and other societies.

When enquiries are made as to how the present breeds of plants and animals originated, it is ascertained that some were derived from natural varieties or elementary species, that others are the descendants of 'sports' which from time to time suddenly made their appearance, but that the majority are crosses or hybrids. For reasons not yet understood, animals and plants, wild and tame, are constantly varying, sometimes in new directions, sometimes in old. When the new or progressive variations are slight they are known as *continuous* variations, when sudden and pronounced they are known as *discontinuous* variations or *sports*. By crossing, man can often induce retrogressive variation or reversion, and by changing the environment he may sometimes set up sporting; but as a rule new variations are accidental and beyond the control of the breeder. Further, only congenital variations are heritable, *i.e.* only characters which originate in the germ cells are transmitted to the offspring—modifications of the mind or body due to use or disuse, to accidents or disease, infection, lack of nourishment, and the like, being incapable of altering the composition of the germ plasm, are not handed on to the offspring. If modifications acquired by the body or *soma* are not transmitted, and if man has little or no power to induce variation in new directions, it follows that the work of the breeder is practically limited to selecting from amongst the useful variations which from time to time appear spontaneously in his flocks and herds, and from the new combinations of already existing characters which result from crossing and hybridizing[1]. In the case of both plants and animals living in a wild state, the selection is made by the environment—the environment in nature playing the part of the breeder. But even in nature there is intercrossing. When the environment is stable, forms which tend to vary are eliminated, but when unstable—it was extremely unstable during the Ice Age—variation is encouraged, and by the intercrossing of varieties which appear new combinations are formed, with the result that wild species have a chance of readily adapting themselves to the new conditions.

As animals and plants living under domestication must, up to at least a certain point, be adapted for their respective environments, and as man can neither control variation nor arrange for the transmission of acquired (non-congenital) characters, the difference between the origin and preservation of wild and tame forms is after all not fundamental. In both cases new types are possible (1) because of spontaneous variation in new directions, (2) because the crossing of variations spontaneously produced leads to new combinations, and (3) because there is selection. In nature, selection except in rare cases leads to uniformity in make, colour, &c., and results in producing forms marvellously well adapted for their surroundings. In animals and plants living under domestication, owing to breeders having different ideals there is often a marked absence of uniformity, and not a few of the varieties bred are neither particularly useful nor beautiful, or specially adapted to their surroundings.

Now that breeders are becoming acquainted with the work of Mendel and his followers, more systematic methods may be adopted. When it is fully realized that animals and plants are built up of distinct and indivisible unit characters, which are inherited according to certain definite principles, each pair of characters being usually inherited independently of one another, and that two or more unit characters can be permanently and rapidly combined to form a new type, the probability is that breeders' methods will be considerably modified. Before indicating how breeders' methods are likely to be influenced by recent enquiries and discoveries, it may be well to indicate how some of the familiar breeds were produced from natural varieties and sports, and by crossing. An example of a breed derived from a natural variety or elementary species we have in the Mungoswell wheat. Many races of plants seem to include several varieties which when isolated breed true. This fact seems to have been recognized nearly a century ago by Patrick Shirreff. In 1819 Shirreff found in one of his fields in East Lothian a plant of wheat which differed from its neighbours by its high degree of branching. As the seeds obtained from this plant bred true, Shirreff was able in a very short time to place a new breed of wheat on the market. In this case, by line-breeding from a single parent plant selected in 1819, a valuable breed of wheat was at once established. In flocks and herds, as in fields of cereals, several varieties may sometimes occur capable, like the wheat plant found by Shirreff, of forming a new race. If we knew more about the origin of the strains or sub-breeds of domestic animals (of, e.g., Southdown and other breeds of sheep, and milking strains of cattle), it might be found that in not a few cases they had been derived by selection from natural varieties rather than from crosses. As an example of a sport we have the once famous Ancon race of sheep. This race or breed was made from a ram lamb with short bent legs which unexpectedly made its appearance in 1791 in Massachusetts. When mature this ram with legs like a Dachshund was mated with a number of normal ewes The offspring obtained, instead of all resembling one of the parents, or being a blend of the parents or their ancestors, had, it is said, either normal legs like their respective dams, or short bent legs like their sire. That in the case of the Ancon sheep there was exclusive inheritance is extremely probable. It is notorious that large and sudden variations are often not only prepotent but persistent It is a simple matter, *e.g.*, to form a breed of four-horned sheep from a four-horned ram; so persistent, in fact, is the four-horned unit character that many generations may elapse before it can be removed by crossing Owing to the prepotency of the short-legged ram, the Ancon breed of sheep was probably as easily formed as the Mungoswell breed of wheat Were the history of the Galloway and other polled breeds of cattle known, it might be ascertained that the majority of them originated, like the Ancon sheep, from sports

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[1] New varieties and species of wild plants are sometimes derived from natural hybrids, but very few species of wild animals arise in this way

If all breeds were derived from natural varieties or from sports, the work of the breeder would be extremely simple As it happens, nearly all the important breeds of animals have been mainly produced by selection after crossing

According to a well-known breeder, the creators of the modern strains of cattle began with a more or less random selection of good specimens of the ordinary stock of the country, the second step was to strengthen the herd by elimination, and to fix excellence by in-breeding and selective breeding, the third was to use freely a good dominant sire, if one fortunately turned up, until the whole herd was permeated by his good blood

Before referring to some of the results obtained in the past by cross-breeders and hybridizers it may be well to insist on the fact that crossing generally leads to reversion, rarely if ever to the appearance of new characters, and that crossing is invaluable not because it induces regressive variation or reversion, but because it provides the breeder with a method by which characters of one variety or breed can be rapidly transferred to another variety or breed[1] A consideration of the breeds formed by crossing indicates that the blending of two varieties or species may be so complete that the hybrids breed true from the first; that it may be of such a nature that the hybrids when interbred produce offspring which resemble the grandsire in some traits and the granddam in others, but nevertheless breed true; and that the blending may be so slight that the hybrids when interbred at once split up to reproduce in a pure or nearly pure form the varieties or species from which they were derived

An example of a cross or hybrid in which the blending is complete from the first, we have in Burbank's phenomenal berry obtained by crossing the Californian wild dewberry (a small species of bramble) and the Cuthbert raspberry. This hybrid (which looks like a gigantic raspberry), instead of splitting up in the second generation, bred true from the outset.

Some breeds of sheep seem to have resulted from an immediate and complete blend of two varieties For example, crosses obtained by mating a Border-Leicester ram with Cheviot ewes, when interbred, breed true, *i e* behave like a sport or a natural variety.

Up to the end of last century it was commonly assumed that while first crosses were generally uniform, subsequent crosses displayed great diversity of character. Now, however, we know that first crosses derived from pure breeds, as a rule, when interbred, either reproduce the original types from which they were derived, or, owing to reshuffling of the unit characters, produce new types, which may from the first breed as true as old-established pure breeds.

The makers of the existing breeds, though unaware that first crosses when interbred behave, with some exceptions, in a definite and orderly manner, sometimes seem to have worked on Mendelian lines An example of a true breed formed by selection after crossing we have in the Suffolk breed of sheep This breed was obtained by crossing the Southdown—a hornless, early maturing breed—with a black-faced horned Norfolk breed In this case the two breeds failed to blend like the Border-Leicester and Cheviot breeds In all probability the Southdown-Norfolk crosses were interbred and the individuals with the points desired selected, *i e* the hornless individuals with a black face which matured early and had lean flesh were selected and made into the Suffolk breed

In the polled Galloway cattle we may have another breed unconsciously created on Mendelian lines As already said, the Galloway breed may have been derived from a sport which behaved like the Ancon ram But as vestiges of horns still occasionally appear in Galloways, the probability is that the first crosses, though hornless, yielded, when interbred, horned as well as hornless offspring. As only some of the polled individuals would breed true, further selection would be required before a pure hornless race was established. In addition to breeds of the Suffolk sheep and Galloway cattle type, that is, breeds made up of individuals uniform in make and colour, there are breeds, some of them of world-wide reputation, which, in at least some of their characters, either behave like hybrids or indicate that they are an imperfect blend of several distinct races.

A well-known example of a recognized breed which never breeds true, we have in the blue Andalusian fowl. This so-called breed is a cross between a black race, and a white race splashed with black. The black and splashed white races breed true, and may hence be regarded as pure breeds. When crossed they produce blue Andalusians, which instead of behaving like the cross between the Border-Leicester and Cheviot sheep,

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[1] For example, by crossing, a cactus may be at once deprived of its spines and a bramble have its thorns reduced to small blunt points, or a valuable wheat highly susceptible to rust may be speedily made immune to the rust fungus.

when interbred, behave like hybrids; i.e. on an average 25 per cent of their offspring are black and breed true, 25 per cent are splashed whites which breed true, and the remainder are hybrids which resemble, and when interbred split up in the same way as, their parents. When blue Andalusians are wanted they are obviously best obtained by crossing the black and the splashed white races. This method yields 100 per cent of blue Andalusians, whereas interbreeding blue Andalusians yields only 50 per cent, the others being 'wasters'.

In the case of the famous Shorthorn cattle we seem to have a breed which, when only the colour is considered, behaves like the Andalusian fowls. The Shorthorn breed seems to have been originally formed by crossing a red and a white variety. The blending having been incomplete, the roans are really hybrids, which, when interbred, split up in the usual way, yielding red, white, and roan offspring. As the red and white as well as the roans are regarded as pure Shorthorns, it may be an advantage rather than otherwise that complete blending has not occurred, for while red is preferred in some districts, roan or white may be preferred in others. Moreover, a breed which consists of two distinct types and their hybrids is less likely to suffer from in-breeding. Breeders of Shorthorn cattle who work on Mendelian lines have, of course, realized that pure reds always produce reds, that pure whites always produce whites, and that pure reds and pure whites invariably produce roans. In addition to breeds which consist only of hybrids, and breeds which consist of hybrids and the pure breeds which produce them, there are breeds which consist of a blend in varying degrees of several distinct varieties or species. The best example of a breed of this kind is the English racehorse. Recent enquiries indicate that the English thoroughbred includes amongst his ancestors four wild species. Fairly typical representatives of these four species occurred in Britain during the first century, hence the British racing ponies which took part in forming the English thoroughbred were in all probability a blend of several types.

About the Arabs, Barbs, Turks, and other foreign breeds which contributed so much to the making of the thoroughbred, very little is known, but if they resembled modern so-called Oriental breeds they also had a multiplex origin. Breeders of racehorses might easily have formed long ere this several distinct strains of thoroughbreds, and bay, brown, chestnut, and other pure strains could readily be made now. As, however, speed is more important than make and colour, the probability is that the thoroughbred will, in the future as in the past, be a breed of great admixture.

While recognized breeds of horses, with few exceptions, are a blend of several types and hence fail to breed true, many of the recognized breeds of dogs are true breeds. This is not because all the domestic dogs have sprung from a single wild ancestor—like horses, dogs had a multiple origin—but because breeders of dogs have made it their business to form a large number of distinct strains, many of which through selection now breed to their own type.

It thus appears that some of the recognized breeds are true breeds, that others are hybrids pure and simple, that others consist partly of hybrids and partly of pure breeds, while others are a blend in varying degrees of several distinct varieties or species. The important question now arises, What is a pure breed, and why do some breeds breed true to type? How, *e.g.*, does the Mungoswell breed of wheat essentially differ from the blue Andalusian breed of fowls? The answer is, that the one is produced from germ cells identical in composition, the other from a union of germ cells (one male, the other female) having a different composition. The one breeds true because all the germ cells produced are practically identical, the other fails to breed true—produces 'wasters'—because the germ cells are relatively as different in composition as the black and splashed white breeds which produced the blue Andalusian hybrids. If the difference between a true and a mixed breed is due to differences in the germ cells, in order to understand breeding problems it is necessary to know something of the structure and behaviour of the germ cells out of which animals and plants are developed.

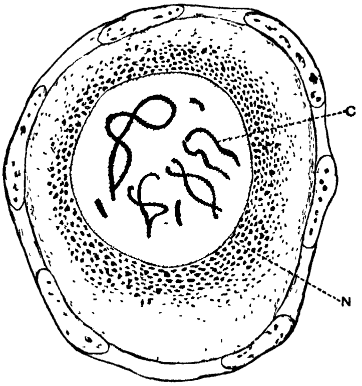

Fig 1 Ovum of Rabbit × 1700

N, Nucleus containing chromosomes (C) (After Winiwater)

Fortunately there is little difficulty in grasping the facts about germ cells which bear directly on breeding problems. The germ cell produced by the female parent, of, *e.g.*, a rabbit consists of a small globular mass of living material (protoplasm) enclosed in a thin capsule or envelope. Near the centre of the cell lies the kernel or nucleus, invested by the delicate nuclear membrane. Under certain conditions the nucleus is seen to contain a number of minute rods, which, because they are easily stained by logwood and other dyes, are known as *chromosomes*. All the members of the same species have the same number of chromosomes—in some animals the chromosomes are few in number, in others they are numerous. As the chromosomes are believed to be 'the carriers of heredity', they form the most important part of the germ cell. It is especially important to bear in mind that germ cells are not manufactured by the parent; they are derived from cells specially reserved for the purpose, and hence the body or soma stands in very much the same relation to the germ cells that a field does to potato tubers planted in it In some cases the fertilized ovum at once divides into two cells, one of which gives rise to the tissues and organs of the new individual (forms the body or soma), while the other eventually gives rise to the germ cells. When an animal is old enough to breed, one or more of the germ cells mature or ripen, and escape from the germ gland In the unripe egg there are two kinds of chromosomes, some inherited from the female, some from the male, parent of the individual in which they are lodged. If there are four chromosomes, two, which may be known as the maternal chromosomes, represent and seem capable of reproducing the female ancestor, while the other two, which may be known as the paternal chromosomes, have been derived from and appear to be capable of reproducing the male ancestor. Each chromosome consists of minute particles, the *chromomeres* During the ripening of the ovum two highly important things happen. In the first place the maternal and paternal chromosomes come into intimate contact with each other, and thus exchange of maternal and paternal chromomeres is made possible. After separating, *either* the maternal or the paternal chromosomes are discharged and disintegrate, with the result that the ovum on reaching maturity only contains half the number it possessed before the process of ripening set in. If during the fusion of the chromosomes an exchange of chromomeres takes place, the composition of the maternal and paternal chromosomes may be materially altered. It may here be mentioned that the sex of the future individual seems to depend on whether the maternal or paternal chromosomes are discharged from the ovum during what is known as the reducing division of the nucleus[1] During the ripening or maturation of the sperms each germ cell eventually gives rise to four cells, each of which contains half the normal number of chromosomes This division may be preceded by the fusion for a time of the chromosomes, and result in the production of two sperms containing maternal and two containing paternal chromosomes—two with an affinity for ova destined to form female individuals, and two with an affinity for ova destined to develop into male individuals When half of the chromosomes have been discharged the ovum is ready to be fertilized, *i.e.* for the entrance of a sperm bringing with it as many chromosomes *as were lost during maturation* *A sperm having entered with its complement of paternal chromosomes*, by some subtle change in the periphery of the egg the entrance of additional sperms is prevented. It thus appears (1) that an unripe ovum contains both maternal and paternal chromosomes, (2) that after the paternal and maternal chromosomes have been in contact with each other for a time (during which chromomeres representing unit characters may be exchanged), either the maternal or paternal chromosomes are discharged, taking with them either the male or the female sex determinant; (3) that the act of fertilization consists in restoring to the ovum by means of a sperm as many chromosomes as were discharged during the reducing division of the nucleus; (4) that neither during fertilization nor during the development of the new individual is there any actual blending of the maternal with the paternal chromosomes; and (5) that whether the new individual develops into a male or a female seems to depend on whether the maternal or paternal chromosomes are discharged from the ovum during the process of maturation, *i.e.* during the halving of the nucleus.

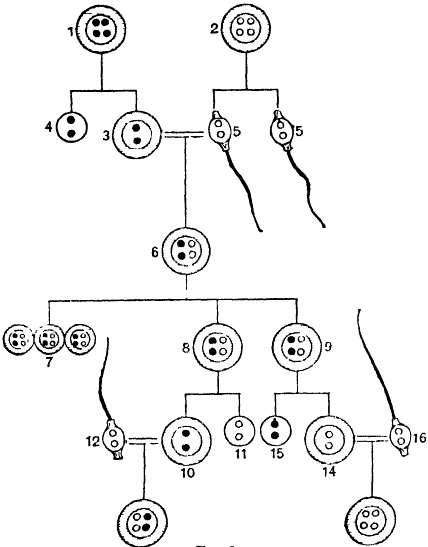

Fig 2

1, A female germ cell, 2, a male germ cell at a corresponding stage, each cell contains four chromosomes 3 and 4 The female germ cell (1) eventually divides into two cells (3 and 4), each with half the normal number of chromosomes—this is known as the *reducing division*, the small cell (4) disintegrates, the large cell (3), if fertilized (*i e* if it receives as many chromosomes as it lost by blending with a spermatozoon) is capable of giving rise to a new individual. 2, the male germ cell, divides to form two spermatozoa (5 5), each with half the normal number of chromosomes 6, A fertilized germ cell containing two maternal and two paternal chromosomes By dividing, 6 gives rise (*a*) to numerous somatic cells (7), which form the body (*soma*) of a new individual, and (*b*) to germ cells (8 and 9) which are lodged in and nourished by the new individual In the case of 8 the paternal chromosomes (11) are discharged and come to nothing, in the case of 9 the maternal chromosomes (15) are discharged during the reducing division. If 10 represents a reduced ovum of a St Kilda ewe and 12 a spermatozoon of a blackface ram, the fertilized ovum 13 will contain both St Kilda and blackface chromosomes and eventually produce a hybrid. If 14 represents a reduced ovum which contains chromosomes derived from a blackface ram, and 16 a spermatozoon of a blackface ram, the fertilized ovum 17, if it develops, will produce a pure or nearly pure blackface sheep

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[1] In female vertebrates certain male characters seem to be latent This is suggested by, amongst other things, hens assuming, as they sometimes do, the plumage, &c , which characterize the male

The structure of germ cells and the phases through which they pass during maturation having been referred to, their behaviour during and after fertilization may now be considered.

The eggs of some animals (*e.g.* Cypris, Daphnia, and certain other Arthropods) on reaching maturity at once develop into new individuals without being fertilized. But ripe ova, though apparently capable of producing unaided new individuals, remain as a rule inactive unless they receive some stimulus from without. In some cases a chemical stimulus is sufficient to start the development (*e.g.* the eggs of the sea-urchin Arbacia begin to develop if placed in a mixture of sea water and chloride of magnesium), but in most cases the necessary stimulus is given by a spermatozoon.

When, as in higher forms, the spermatozoon comes from a different individual—the male parent—it not only starts the development but plays an important part in forming the new individual, which, as Huxley once said, 'may be compared to a web of which the warp is derived from the female and the woof from the male.' This being the case, it is important that the ova of any given variety or race should select spermatozoa produced by members of the same or of a nearly related variety or race, otherwise, in the case, *e.g.*, of marine animals, in which fertilization takes place in the sea, distinct species would cease to exist, while in the case of terrestrial animals (except when the females have a marked preference for mates of their own type) hybrids would be of common occurrence. This selection between the germ cells, or gametes, is known as *gametic selection*. It has long been realized that gametic selection occurs in plants. Darwin, *e.g.*, pointed out that if 'pollen from a distinct species be placed on the stigma of a castrated flower, *and then after the interval of several hours, pollen from the same* species be placed on the stigma, the effects of the former are wholly obliterated except in some rare cases. If two varieties are treated in the same manner the result is analogous, though of directly opposite nature, for pollen from any other variety is often, or generally, prepotent over that from the same flower' (Cross-fertilization of Plants, p. 391).

Preferential mating, *i.e.* the selection of the female (or male) of a mate, may go a long way in higher forms in preventing intercrossing of races, but this is usually supplemented by gametic selection. A recent experiment illustrating preferential mating and gametic selection may here be mentioned. In 1907 a St. Kilda ewe (which in 1905 and 1906 produced ewe twins to blackface rams), also a St. Kilda lamb ewe, and four St. Kilda blackface crosses were mated with a pure blackface ram lamb. About an hour afterwards the two St. Kilda ewes were served by a St. Kilda ram, but the four St. Kilda-blackface crosses refused to receive the addresses of the St. Kilda ram. In 1908 the four crossbred ewes had lambs to the blackface ram, but the St. Kilda ewes had pure St. Kilda rams, *i.e.* the St. Kilda-blackface crosses had a preference for the pure blackface ram, while the ova of the St. Kilda ewes selected sperms of their own kind in preference to the already present sperms of the blackface breed.[1]

A general consideration of germ cells leads one to the conclusion that the affinity between mature ova and mature sperms varies greatly. It is, *e.g.*, so feeble between the ova of sheep and the sperms of goats that no offspring are produced; it is sufficiently strong between the ova of St. Kilda and blackface sheep to result in the production of crosses, and so great between the ova and sperms of the St. Kilda race that St. Kilda ova select St. Kilda sperms in preference to sperms of the blackface race.

When, as sometimes happens, a female proves sterile with one sire (which gets stock with other females of the race) but fertile with another sire, the sterility may be due to want of vigour in one or both of the germ cells, but it is probably sometimes due to gametic selection. This is suggested by the behaviour of a mare of the Celtic type from the north of Iceland which proved sterile with a zebra, an onager, an Arab, and four other breeds of horses, all of which were stock-getters, but at once proved fertile when mated with a pony of her own type from the west of Ireland.

It is important to bear in mind that the union of the ovum and sperm which takes place during fertilization does not imply a complete blending of the male and female chromosomes. On the contrary, the chromosomes derived from the male parent may be said to engage in a friendly struggle with the chromosomes derived from the female parent. Sometimes the male chromosomes prevail, with the result that the new individual resembles the sire; sometimes the female chromosomes control the development, and lead to the production of offspring the image of the dam. When the male and *female chromosomes take about an equal share in dominating the development, the offspring* are nearly intermediate in their characters, but when the parents belong to distinct strains, varieties, or species, the offspring, owing to reversion, instead of resembling one parent or being a blend of both parents, often resemble a remote common ancestor. Evidence of the view that the male and female chromosomes retain their identity, that they blend neither at the moment of fertilization nor during development, is obtained by interbreeding crosses with one of their pure parents. The writer's St. Kilda-blackface hybrid ewes, when mated with a pure blackface ram, yielded an equal number of pure blackface lambs and St. Kilda-blackface hybrids. This implies that St. Kilda-blackface hybrids, instead of producing hybrid or blended ova, seem to produce pure ova—50 per cent practically identical with the ova of pure blackface sheep, and 50 per cent with the ova of St. Kilda sheep. In other words, each St. Kilda-blackface hybrid behaved as if one of the ovaries contained pure St. Kilda ova, the other pure blackface ova. In all probability some of the germ cells of the St. Kilda-blackface hybrids behave like pure St. Kilda germ cells and some like pure blackface germ cells—(1) because during the halving of the nucleus the chromosomes derived from the male parent are discharged from some ova, while the chromosomes derived from the female parent are discharged from others; and (2) because the sperms are produced in such a way that 50 per cent contain chromosomes derived from the one breed, and 50 per cent chromosomes derived from the other breed.

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[1] The writer understands that Ayrshire cows are sometimes put to a Galloway bull before they are served by an Ayrshire bull. When this plan is resorted to, the calves are said to be invariably pure Ayrshires.

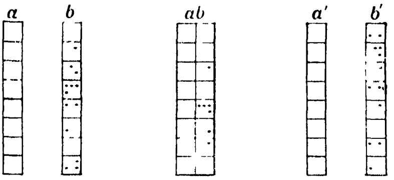


Fig. 3

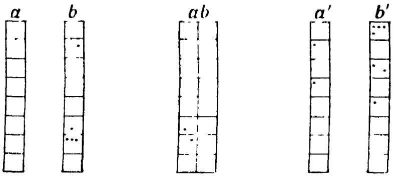


Fig. 4

Diagrams to illustrate what is supposed to happen during the Conjugation of the Chromosomes

Fig. 3, *a*, a chromosome derived from the male parent, *b*, a chromosome derived from the female parent—each chromosome consists of several *chromomeres*. *a b*. The paternal and maternal chromosomes in contact with each other: during conjugation there is probably always an exchange of protoplasm between the paternal and maternal chromosomes. *a' b'*. The chromosomes after conjugation. During the halving of the nucleus *a* the other chromosomes on the paternal side may be retained, and eventually take part in forming a new individual, or the *a'* chromosomes may be discharged, and *b* and the other chromosomes on the maternal side retained to assist in forming a new individual. Fig. 3 indicates what probably happens during the conjugation of highly exclusive chromosomes—during, *e.g.*, the conjugation of the chromosomes in the blue Andalusian (hybrid) fowl, in which there is so little blending between the paternal and maternal chromosomes (the chromosomes derived from the black and splashed white breeds), that some of the germ cells of blue (hybrid) Andalusians are as pure or nearly as pure as the germ cells of the black breed, while others are practically as pure as those of the splashed white breed. Fig. 4 indicates what probably happens when there is a reshuffling of the chromomeres (or whatever represent unit characters) during conjugation. In this case the paternal and maternal chromosomes, instead of being exclusive, freely blend, with the result that during conjugation the composition of the chromosomes is more or less altered. For example, if the *a* series of chromosomes represent a hornless race of blackfaced sheep and the *b* series represent a horned race of whitefaced sheep, the *a'* series might be so altered during the reshuffling of the units during conjugation that on uniting with a sperm containing similarly altered chromosomes a sheep would be produced characterized by horns and a black face.

But while many hybrids in the matter of germ cells behave as if they were two pure individuals rolled into one—produce germ cells 50 per cent of which on an average have the composition of the germ cells of the variety or race to which their sire belonged, while 50 per cent agree with the germ cells of their dam—there are hybrids which produce germ cells of a mixed type—which, instead of producing pure offspring, give rise to individuals in which the characters of the two pure races from which the hybrid was derived are more or less blended. For example, when crosses between a variety of wheat liable to 'rust' and a variety immune to 'rust' are interbred, immunity to 'rust' may be acquired by the variety which previously suffered from the 'rust' fungus. Again, crosses between a horned whitefaced race of sheep and a hornless blackfaced race, when interbred, may produce a blackfaced hornless race which breeds true. This transference of characters from one race to another is possible because each variety has certain characters (generally known as unit characters), which are exchangeable with what may be known as complementary or contrasted characters of other varieties. Some of these unit characters (*e.g.* horns of deer, the beard of man, and the numerous male decorations of birds) are obviously sexual characters, while others are probably correlated to sexual characters. It may be assumed that each unit character is represented in the germ cell by one or more chromomeres or by certain of the particles of one or more chromomeres. An opportunity is afforded the germ plasm representing one or more unit characters being exchanged with the germ plasm representing the complementary or contrasted characters during the conjugation of the chromosomes. For example, in the case of a hybrid between a black horned and a white hornless variety, the germ plasm in the ova and sperms representing the horns of the one race may exchange with germ plasm representing the polled condition of the other, with the result that the hybrids when interbred would have amongst their progeny black individuals without horns and white individuals with horns, which from the outset might breed true each to its own type.

The conjugation of the chromosomes seems sometimes to afford an opportunity for long-separated particles to recombine, with the result that from mixed types pure, and it may be remote types are reproduced. Recent enquiries led the writer to conclude that Arabs, Hebridean, and certain other ponies, included amongst their wild ancestors a variety characterized by, amongst other things, a small narrow head, slender metacarpals, and the absence of the hind chestnuts and all four fetlock callosities or ergots. It occurred to him that this fine-limbed ancestral type (*Equus gracilis*) might be reproduced by selective breeding. To give *E. gracilis* of the Auvergne Pleistocene deposits a chance of reappearing, he crossed a Shetland pony mare of the Fetlar type, having metacarpals as fine as in the small horse of Auvergne, with a slender-limbed Arab ('Rajah'). In both Shetland and Arab the head was somewhat coarse, and the hind chestnuts were present, but the ergots were either small or absent. In the Arab-Shetland cross obtained the head is somewhat large, but the tail is well set on, the limbs are fine, the hind chestnuts are small, and all the ergots are absent. This cross, a mare, was mated with a high-caste Arab ('Parakh') having a fine head but powerful limbs, bearing a complete set of callosities—four chestnuts and four ergots. The result was in 1907 a foal with a fine head and slender limbs having neither ergots nor hind chestnuts, and in 1908 a foal provided like its sire ('Parakh') with all the eight callosities. As similar results have been obtained by crossing Iceland, Welsh, and Highland ponies, the appearance of the 1907 Shetland-Arab foal with only two callosities was evidently not a mere coincidence. When the ova of the St. Kilda ewes selected St. Kilda in preference to blackface sperms, we had cellular selection. But in addition to cellular selection—selection between complete germ cells—there seems to be intracellular selection, due doubtless to some of the particles which make up the chromomeres having a special affinity for each other. In the case of the ovum out of which the 1907 foal without ergots and hind chestnuts was developed, we may assume that, during the conjugation of the chromosomes derived from the Fetlar mare with those from the Arab stallion, there was a reshuffling of the germ units which resulted in the granules of germ plasm which represented the Pleistocene species *E. gracilis* aggregating in the maternal chromosomes, and the collection of granules representing other ancestral types in the paternal chromosomes. During the reducing division the paternal chromosomes (carrying with them the male sex determinant) were discharged, and the ripe ovum of the Arab Fetlar cross subsequently proving more prepotent than the sperm from the Arab 'Parakh', a filly foal was eventually produced without hind chestnuts and ergots—a foal which probably reproduces the points of the small, fine-limbed horse of Auvergne. In the following year, in all probability the same intracellular selection—the same reshuffling—took place, but the maternal instead of the paternal chromosomes were discharged during the halving of the nucleus of the ovum, with the result that the 1908 foal, instead of reproducing an ancestral type, resembles in the callosities, sex, and other points 'Parakh', its actual sire.

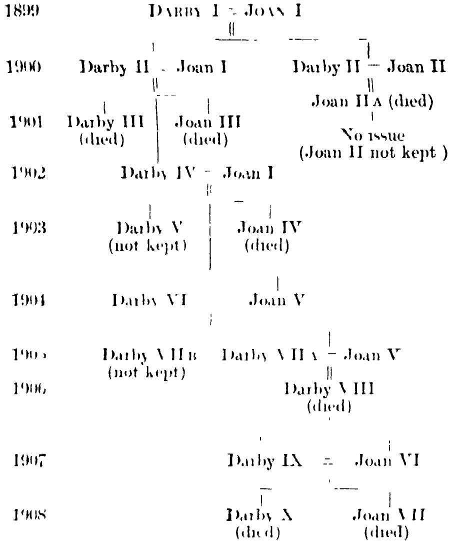
The theoretical aspect of the subject having been dealt with, the actual work of the breeder may next be considered. The work of the majority of breeders consists mainly in maintaining at a high standard already existing strains. This may be comparatively easy or extremely difficult. It is simple when it consists of reproducing well-fixed, pure, vigorous types, difficult when reversion or sporting is common, or when through inbreeding or unfavourable conditions there is a loss of size, vigour, or fertility, or when, owing to unsuitable sires being selected, there is a loss of the points which at the moment happen to be in favour. Some breeders succeed, though they know but little of the theory of breeding, and have a very imperfect acquaintance with the history of the strains they handle; while others, who have made a study of the laws of heredity and of the origin and history of domestic animals, meet with but little success. But though breeders, like poets, are born, not made, it is desirable that even the most successful breeder should know something of the theory of breeding, and as much as possible of the history and peculiarities of the breeds to which he directs his attention.

It is important at the outset to ascertain whether any given breed—be it plant or animal—is pure—breeds true to its own type. When (as in the case of the Mungoswell wheat) the breed has descended from a single pure parent (unless sporting or hybridizing has taken place), it will from the outset be a pure breed, *i.e.* the male and female germ cells will be alike in composition and the variation will be limited. When, on the other hand, two varieties or races selected to form a breed refuse to blend (as in the case of the Andalusian fowls), the breed may consist entirely of hybrids, or (as in the case of the Shorthorn) of two pure varieties as well as their hybrids. In such cases the germ cells retain their purity, with the result that the pure types are constantly being reproduced when the hybrids are interbred. When three or more pure varieties are bred indiscriminately, the germ cells usually in course of time lose their purity (the types are broken down and analogous unit characters combine), with the result that instead of having either pure varieties or hybrids (first crosses), we have mixtures in which the characters of three or more types are blended in varying degrees. The English thoroughbred is made up of crosses of this kind.

As most breeds have been formed by line breeding—from individuals belonging to a single line or closely related lines of descent—one of the difficulties breeders have to contend with is loss of size, vigour, or fertility from in-and-in breeding. In some cases inbreeding seems to do little or no harm, in others it is said to lead rapidly to deterioration. It seems to benefit wheat, but prove hurtful with maize, to lead sooner or later to disastrous results in dogs and pigs, but do little or no harm, if judiciously carried on, in the case of horses and cattle. Inbreeding is probably common amongst wild animals, and members of herds formed from escaped domestic animals are doubtless often intimately related. In the case of wild animals and of the descendants of domestic animals run wild, there is little or no evidence of loss of vigour or fertility, partly because the weaklings are eliminated, and partly because there is now and again a restoration of vigorous individuals by reversion.

The effects of incestuous breeding in at least a section of the Ruminants will be gathered from an experiment with goats. In 1899 the writer procured a pair of goats believed to be unrelated and healthy. Darby I, the male, was of a dark-brown colour; Joan I, the female, was of a white-and-fawn colour. The first kids were born in April, 1900. The female kid (Joan II) was large and vigorous at birth, but the male (Darby II) was small, and so feeble that but for careful nursing he would only have survived a few hours. As the table indicates, Darby II was allowed to breed when only about eight months old—in a wild state male goats probably rarely have a chance of breeding until they are two or three years old.

INBREEDING EXPERIMENT WITH GOATS



In 1901 Joan I had two light-coloured kids by her son (Darby II), and Joan II had a pure-white kid by her brother (Darby II). All three kids died, the twins soon after birth, the white one when six weeks old.[1] In 1902 Joan I had a vigorous kid (Darby IV) by her son (Darby II), and in 1903 a pair of kids by Darby IV, one of which (Joan IV) died soon after birth, the other (Darby V), though fairly vigorous, was given away. In 1904 Joan I had again kids (Darby VI and Joan V) by Darby IV, both of which survived, and produced in 1905 two extremely robust male kids (Darby VIIA and Darby VIIB) which in make and colour resembled Darby I.[2] In 1906 Joan V had a male kid (Darby VIII) by her vigorous son Darby VIIA, which died soon after birth, and in 1907 a pair of kids (Darby IX and Joan VI). In 1908 Darby IX and Joan VI had a pair of kids so small and delicate that they only lived a few hours. Now that Darby IX and Joan VI are nearly eighteen months old they are well grown and vigorous, and likely to produce a pair of strong, healthy kids next spring. From the first the goats were allowed to live a semi-wild life, to find their own food (except when snow was on the ground) and their own shelter. The high death-rate is partly due to both the males and females being allowed to breed as soon as they reached maturity, *i.e.* when about eight months old. As it happens, the pair now living are, as far as I can tell, as vigorous as their ancestors Darby I and Joan I—there has been neither loss in size nor in fertility. That any of the goats are left is, I believe, due to the fact that the males born in 1905 were extremely vigorous—that five years after the experiment was started Darby I was as it were reproduced with his strength unimpaired.

From the goat experiment it may, I think, be inferred that by making use of the vigorous individuals which from time to time appear in herds of Ruminants, the size, vigour, and fertility can be maintained for an unlimited period without the introduction of fresh blood. When, however, owing it may be to the absence of selection and reversion, a herd undergoes degeneration, the vigour can only be restored by resorting to intercrossing. When intercrossing is necessary it is sometimes difficult to decide whether to introduce one or more sires from an allied strain of the same breed, or use sires belonging to different breeds. When, as in the case of the English racehorse, the breed was originally formed from several perfectly distinct races, the rejuvenation of a strain or family should be readily effected by using vigorous sires belonging to a different strain or family. When, however, the various strains of a breed are not only closely related but belong to the same type—this is more or less the case with English foxhounds—it is better to use a sire from a perfectly distinct vigorous breed. The first cross having been obtained, the question arises, what should be done next? The usual procedure is to cross back—to mate the best available crossbred male with pure-bred females. According to Mendel's law, 50 per cent of the offspring obtained in this way should have at least the more striking points of their pure dams and breed true. A better plan would perhaps be to breed the crossbred females with a pure male belonging to a different strain from their sire. Of the offspring obtained in this way, about 50 per cent would probably be pure and breed true, and having been bred and reared by crossbred females they would almost certainly be more vigorous than the offspring of pure females by a crossbred male. How to rejuvenate on Mendelian lines will be made plain by an example. By crossing St Kilda ewes by a blackface ram, the writer obtained a number of crosses (or hybrids) in which the characters of both breeds are more or less blended. On the assumption that the germ cells produced by the hybrid ewes would be pure (some of them as pure as the germ cells of their blackface sire, some as pure as the germ cells of their St Kilda dam), they were next mated with a blackface ram belonging to a different herd from that of their sire. Half of the lambs produced by the crosses are obvious hybrids, the other half have all the points of the blackface breed and appear to be extremely vigorous.

To rejuvenate British foxhounds the best plan would probably be to cross several bitches belonging to a pure but vigorous race (or several female wolves) with a carefully selected foxhound dog, and then breed the female hybrids with a foxhound dog from another kennel. Of the offspring of the hybrids, 50 per cent or thereabout would probably be nearly pure foxhounds and the rest hybrids. By mating the female hybrids of the third generation with a foxhound dog from a third kennel, another generation would be obtained consisting of pure foxhounds (about 50 per cent) and hybrids. In this way a sufficient number of vigorous pure or nearly pure foxhound dogs and bitches would probably be obtained to restore the vigour of all the packs in Britain.

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[1] When animals are allowed to breed before they come to their strength—when, *e.g.*, Shetland ponies are allowed to breed before they are eighteen months old—the offspring are often so feeble that they either die soon after birth or are reared with difficulty.

[2] It will be noted that the vigorous kids were the offspring of twins and were both males, and it may be added were born before their parents were twelve months old.

Another mode of procedure on Mendelian lines would be to interbreed the first crosses. For example, of a score of Ayrshire cows belonging to a strain in need of rejuvenation, ten might be mated with a Highland bull and ten with a Galloway, and the hybrids afterwards interbred—the females by the Highland bull being put to males by the Galloway bull, and vice versa. About 25 per cent of the offspring of the hybrids would be pure or all but pure Ayrshires.

The many experiments made point to the following conclusions: (1) That, unless inbreeding has been carried too far, it ought to be possible to arrest loss of size, vigour, and fertility by selection; (2) that by selection it ought to be possible to prevent reversion; and (3) that by taking advantage of the prepotent sires which from time to time appear, it ought to be possible to maintain a breed at a high standard, and, unless a limit has already been reached, gradually improve it in one or more directions.

While some breeders direct their attention to breeding pure stock, and more especially to producing high-class sires, others concern themselves with breeding crosses. Though by no means a light task, the breeding of crosses is neither so costly nor attended with so many risks and difficulties as producing pure breeds. The cross-breeder may get his sires ready-made from one source, and he may procure the dams from another, and as long as he limits himself to blending two pure breeds, granting the conditions are favourable, his work is comparatively simple. When, however, he proceeds to interbreed the hybrids, or cross them with pure breeds or with other hybrids, he will find himself in a sea of difficulties out of which he may be unable to steer himself, however great his experience and profound his knowledge of the laws of breeding. The maker of half-breeds has especially to consider prepotency—a subject about which, unfortunately, we still know surprisingly little. Perhaps it is best, with Galton, to regard prepotency as a 'sport'. Pure and inbred animals are prepotent, yet a sire formed by blending several distinct types may prove still more prepotent, and, as everyone knows, 'sports' are as a rule highly prepotent. In some breeds the males are usually more prepotent than the females, in others the females are more prepotent than the males. When a breed consists of hybrids as well as pure individuals, the prepotency is likely to vary—*e.g.* a red or a white Shorthorn is likely to prove more prepotent than a roan Shorthorn; and when, as in the case of the English thoroughbred, a breed has sprung from three or four wild species, one individual may be a nearly pure member of an ancient race and be accordingly prepotent, while another individual with as good a pedigree may be a blend of several races, and though well made and of a good colour, may count for little in his offspring.

When it is necessary to raise the standard of the stock of any district, or for economic reasons convert one breed into another, intercrossing has to be resorted to. There are two laws bearing on operations of this kind, viz. Galton's law of ancestral heredity and Mendel's law. According to Galton's law, the immediate parents contribute one-half, the grandparents one-fourth, the great-grandparents one-eighth, and so on of the total heritage of the average offspring. If the two parents contribute 50 per cent, the two grandparents 25 per cent, and the others an ever-diminishing amount, it follows that the generations beyond the sixth only contribute 1 per cent of the characters. This being the case, the sixth cross may be regarded as pure. According to Galton's view, when no allowance is made for prepotency or reversion, the foundation stock, instead of being all-important, counts for least, the last or sixth generation for almost everything. To convert, say, a mixed herd of cattle into a Shorthorn herd, the cows might be crossed with, say, a red Shorthorn bull, the first heifer crosses would be crossed with a similar Shorthorn bull belonging to a different family, and the crossing would be continued (each generation of heifers being mated with a different red bull) until the sixth generation of crosses was obtained, all of which—males as well as females—would in all probability have the points of red Shorthorns and breed true. By proceeding on the same lines a herd of Highland cattle could be converted into a herd of Shorthorns or Galloways. But even if the crossbred heifers produced a calf when two years old, the process of grading a mixed herd up to a high level, or transforming a herd of Highlanders into Galloways, would be tedious, long, and costly. If instead of crossing back until the fifth or sixth cross is obtained, the crossing is done on Mendelian lines, the desired goal would be reached in less than half the time, with, it may be, more satisfactory results.

The writer is not aware that a herd has either been graded or converted on purely Mendelian lines, but the method of procedure is obvious. If, *e.g.*, it was decided to convert a herd of Galloways into Shorthorns, the cows would first be put to as many white Shorthorn bulls as the district could produce. The crossbred heifers when mature might either be put to unrelated Shorthorn bulls or to unrelated Galloway-Shorthorn crossbred bulls. Of the second crosses—the offspring of the Galloway-Shorthorn heifers and pure Shorthorn bulls—50 per cent would be pure or nearly pure Shorthorns, *i.e.* 100 Galloway-Shorthorn heifers mated with unrelated pure Shorthorn bulls might yield 50 pure Shorthorn heifers—a sufficient number to form the nucleus of Shorthorn herd. If, instead of putting the Galloway-Shorthorn heifers to Shorthorn bulls, they were put to several Galloway-Shorthorn bulls, 25 per cent or thereabout of their offspring would be pure or nearly pure Shorthorns, 25 per cent Galloways, and 50 per cent Galloway-Shorthorn crosses or hybrids. In some cases it would doubtless be found better, as well as more expeditious, to put the hybrid females to a pure-bred male, in other cases to interbreed the hybrids—when only one or two pure males were available the latter plan would probably be best, as the offspring would be less inbred.

When a breed consists of two strains, one well made, the other not so shapely but of a better colour or disposition, or noted for its speed or fertility, or yield of milk, it is conceivable that it might be an advantage to combine the desirable traits into one strain In some cases the desired blend may be unattainable, but if it was decided to attempt to effect the combination the procedure would be very simple. If, *e g*, it was desired to unite into one strain the strain of Ayrshires or Shorthorns noted for its milk record with the strain noted for its symmetry, a number of shapely bulls would be mated with cows (as many as possible) noted for their milk record, and the offspring subsequently interbred As the germ cells matured in the offspring (*i e* during the conjugation of the chromosomes), in some cases the particles of germ plasm in the paternal chromosomes which represented the fine make, might be transferred to the maternal chromosomes which represented a great yield of milk, with the result that some of the next generation would unite shapeliness to a high milk record

In addition to uniting in one variety characters which are known to exist in other varieties, breeders may sometimes restore a long-lost variety The writer has had an experiment of this kind in hand for some years From fossils found in France it has been known for some time that during the Ice Age Europe possessed a small horse with slender limbs, a fine narrow head, and small teeth a species apparently represented now by high caste desert Arabs and the Celtic pony While in Mexico some years ago the writer came across ponies which fairly well realized his conception of the small, slender-limbed horse of the Stone Age, and similar ponies are still met with in Andalusia By crossing Welsh, Connemara, Shetland, and Arab ponies he has now obtained a pony which differs from all its recent ancestors in the head, limbs, and the carriage of its tail a pony which in all probability through reversion reproduces in a nearly pure form a wild race which has been extinct for thousands of years

It has already been indicated that the work of the breeder is almost limited to selecting, to doing for domestic animals what the surroundings do for wild animals But while the breeder (though capable of making new blends by intercrossing) is unable to produce new varieties, he should always be on the outlook for the new varieties (sports or mutations) which now and again spontaneously appear in domestic animals. Unfortunately, many of the sports which appear, instead of presenting desirable characters well worthy of being perpetuated, are highly undesirable. The only sports which have appeared during the writer's experiments were tailless rabbits, and rabbits which had the faculty of rapidly spinning round like waltzing mice Should, however, a sport appear which adds appreciably to the value of a breed, there need not be any longer any difficulty in preserving it. If the sport is remarkable for its coat or colour, speed, size, vigour, or fertility, yield of milk or of beef, or in the case of plants for the quality of the flowers, fruit, seeds, tubers, or stems, by taking advantage of Mendel's discoveries it can as a rule be easily perpetuated. The probability is that the sport will prove highly prepotent, but whether when crossed it proves dominant or recessive, it will almost certainly reappear and breed true when the crosses are interbred.

In dealing with the principles of breeding, a considerable amount of space is usually devoted to the transmission of acquired (non-congenital) characters and maternal impressions, to variation and heredity, to prepotency and the determination of sex, to discussing whether the male or the female is responsible for the external characters; but these and other like problems are either too large or too obscure for treatment here, or they have already been dealt with as far as is possible in an article of this kind [J. C. E.]

Bresse Fowl. — The district of France known as the Bresse country, to the south of Burgundy, in the Departments of Ain and Saône-et-Loire, is the home of the above fowl, the most famous of French table poultry, commanding the highest prices on the Paris and other markets, a position which it well deserves for its quality of flesh The appearance of the bird indicates that it has close affinity with the Italian races, but has been modified by many generations of breeding on the rich lands of La Bresse, and by selection for the special qualities which distinguish it In shape and size of body, in carriage, in comb, it might be mistaken for a Leghorn, the chief difference being that the comb is not quite so large, the legs are blue-grey instead of yellow, and the flesh and skin are beautifully delicate and white in colour When we remember that Italy is near at hand, across the western Alps, and that at one time by the St Bernard Pass this district was on the highway from Northern Italy to Central France, it can be seen how easily any race of fowl could pass from one country to the other. Even if that be so, to the French breeders must be given credit for modifications which have resulted in the production of this magnificent breed of table fowls Of it there are four varieties, namely, black, white, grey, and blue, but the last named is less seen than are the others, each of which are found in districts where they are almost exclusively bred. The writer has had the opportunity of visiting the Bresse country, and of seeing the birds both upon the farms and in the local markets, and in no country with which he is acquainted is the skill of the peasants more manifest The prices obtained for well-fed specimens are large, and the farmers find poultry-breeding one of the most profitable branches of their industry.

In size these birds are small medium, and at first it would never be thought that they were table fowls, as they are more like layers The males do not in lean condition exceed 6¼ lb, and the females 5½ lb, but the peculiarity is that they fatten to a remarkable extent, often reaching 9 lb. This is by no means an excessive weight, and is exceeded by many other breeds of fowls. The body is long, and oblong, rather than square as in other races, a result of which is that they have a light appearance, added to by the fact that they are very active in habit, and, as a rule, excitable in the presence of strangers, thus exactly the opposite of many of our meat-producing races, in which a quiet disposition is usually sought for. The neck is short, the head small and fine, and the comb, standing upright in the cock and falling over in the hen, is very fine in texture, in itself a sure indication of fineness of flesh. The legs are of medium length, and the bone is slight and very fine, as is that of the entire skeleton. In fact, this is one of the great recommendations of the breed, for, *pro rata*, the weight of bone to that of the entire body is small, although the carcass is roomy, giving plenty of space for the laying on of a large amount of flesh. On examination of the sternum, and bones of the wings and legs, we have been surprised to find that they were so light, considering the amount of flesh upon them. The meat has a special nature, which we have found in few other breeds, namely, that it is what may be termed 'short', and the fibre is scarcely apparent at all. Something of this may be due to the manner of rearing and feeding, but not entirely so, and it is a quality which enhances the value of the Bresse fowl for table purposes. The amount of meat on a well-fatted Bresse fowl is remarkable, and the non-edible portions of the carcass are brought to the lowest limit. As a rule, the hens of this race are excellent layers of good-sized white-shelled eggs, which are fine in quality. The Bresse requires a kindly soil, and could not be produced to the same standard of quality as in their native district, except upon rich land. Further, to secure the best results, the chickens should be suitably fatted before they are killed. [E. B.]

Brewers' Grains are the residue of barley and malt after these have been employed in the brewing process. In the operation of 'mashing', the carbohydrates of the barley and malt are converted, by the agency of the diastase in the malt, into sugar, and are removed in the wort. The grains are then taken out of the 'mash tun', and are either used direct when fresh, as 'wet brewers' grains', or they are dried by special machinery and then sold as 'dried grains'. They contain, of course, all the husk of the barley, and along with this a good deal of the nitrogenous matter, which it is the aim of the brewer to remove as far as possible from the beer.

Wet brewers' grains, as removed from the brewery, are carted away when still hot, and are made use of in the immediate vicinity. The high percentage of moisture which they contain prevents their profitable transit to any distance. As a rule they are used in their fresh state, but occasionally they are stored in pits or similar receptacles, and kept for subsequent use, much in the same way that silage is preserved. In such cases it is not unusual to put a little common salt with the grains.

When required for sending to further distances, or for keeping purposes, the wet grains are dried by special machinery, and are then known and sold as 'dried grains'. *In this form they will keep well, if properly dried, and form a very useful food which is in considerable demand.* Wet brewers' grains are employed almost entirely as a food for milking cows, where the demand is for a large milk yield. When kept for even a short period the wet grains become distinctly acid in character, the acidity being to some extent due to lactic acid, and they exercise a stimulating effect upon the animal, tending to an increased flow of milk. The quality of the milk is, however, decidedly deteriorated, and if the grains be fed at all freely, and be not supplemented with cake or meal, considerable risk is run of the quality of the milk falling below the legal requirements. The quantity given per head daily to milking cows is from ¼ to ½ bushel, the latter being rather an extreme amount. Wet brewers' grains are considered to be unsuitable for giving to cows when approaching the time of calving, as tending to produce abortion.

The dried grains, on the other hand, have no harmful or deteriorating effects, and are freely used alike for horses, fattening cattle, milking cows, and sheep. They are, as a rule, very well prepared, and are clean and free from impurities. Distillers' grains, which are similarly prepared, contain other grains such as rye and maize, in addition to barley.

For sheep, dried grains seem to have a special value, and, by reason of their fibrous nature, are capable of replacing to a considerable extent the use of hay. Half a pound per head daily is a good feed for sheep. The average composition of wet and dried brewers' grains respectively is represented by the following analyses.—

	Wet Grains	Dried Grains
Water	76·2	9·5
Fat	1·7	7·0
Albuminoids	4·9	19·8
Amides	·2	·8
Soluble carbohydrates	10·7	12·3
Woody fibre	5·1	15·9
Ash	1·2	4·7
	100·0	100·0
Nitrogen	·81	3·29

The ratio of nitrogenous to non-nitrogenous matters is 1 : 3·3. Of the nitrogenous substances 70 per cent are digestible, of the carbohydrate matter 63 per cent, and of the woody fibre 39 per cent.

The ash constituents contain a relatively good proportion of phosphoric acid. The manurial value of the wet grains is, because of their high moisture contents, almost negligible, but that of the dried grains is material. According to Lawes' & Gilbert's tables, as modified (1903) by Voelcker & Hall, the respective compensation values for 1 ton of each food consumed are:—

	For the last year	Second year.	Third year	Fourth year
Wet brewers' grains	6s.	3s.	1s. 6*d*.	9*d*.
Dried grains	24s. 3*d*.	12s. 1*d*.	6s.	3s.

The ash contains —

	Wet Grains	Dried Grains
Phosphoric acid	42	1 61
Potash	·05	20

[J A V]

Brewers' Waste.—Under this head may be included such materials as spent hops and waste yeast, which are removed at different stages of the brewing process In addition, there are the washings of the tuns, barrels, and other vessels, these being sometimes used as food for pigs, but more generally allowed to run to waste The disposal of this waste is, however, apt to give rise to considerable trouble, especially when it is passed direct into sewers Spent hops are occasionally utilized, after drying, as a constituent of certain mixed feeding-cakes, but they are more generally employed as manure Their composition may be represented as follows —

Water	73 97
[1] Organic matter	21 83
[2] Phosphoric acid	42
Alkaline salts	39
Lime, &c	22
Siliceous matter	17
	100 00

[1] Containing nitrogen	82
Equal to ammonia	1 00
[2] Equal to tribasic phosphate of lime	92

Spent hops are, of course, not valuable enough to be conveyed any considerable distance, but may, if near at hand, be used as an organic manure, mainly for vegetable and market-garden purposes They may be thrown into heaps with stable manure, &c , or put in compost heaps

The waste yeast obtained in breweries is a difficult material to handle, because of its tendency to turn into a semi-liquid mass, and because of the rapidity with which it turns mouldy and becomes useless. Many attempts have been made to obtain it in portable form, and in such state that it will keep for a reasonable time The yeast has been mixed with various feeding-meals and the whole dried together, so as to form a mixed food retaining the feeding properties which the yeast possesses Other processes have had as their object the obtaining of the waste yeast in a dry form for use as manure Admixture of it with lime is one of the methods that has been employed Recently, by improved methods of treatment and drying, products have been obtained which bid fair to be successful in preserving the feeding and manurial qualities possessed by yeast

[J A V]

Brick Earth. A term given, especially in the south of England, to a loam suitable for brickmaking, occurring as a superficial deposit on various types of strata Sometimes it represents an old alluvium, sometimes it is identical with loss (see art LOESS) In other cases it includes angular blocks from adjacent slopes, and has accumulated through the wash of rain down the hillsides, at no great distance from the source of its materials. Brick earth forms a loamy soil of great fertility, well adapted for nursery grounds and market gardens in the typical area of the Thames valley, where it is often underlain by valley gravel (Mem. Geol. Survey; Soils and Subsoils, 2nd ed , 1906, and Geology of London, vol i, 1889) The brick earth, in places 30 ft thick, in the lower reaches of the Thames valley is clearly a form of alluvium It forms flat lands between Windsor and Hounslow, and overlies the stiff London Clay near North and South Ockendon, in Essex. Similar materials are also found, overlying 'clay with flints' for the most part, on the marginal plateaus round the Thames basin, as at Hatfield in the north, and Burgh Heath and Knockholt on the south.

[G A J C]

Bridges. See ROADS AND BRIDGES

Bridle.—The bridle is that portion of harness which is worn upon the head of a horse or other animal ridden or driven by man By its means the bit is retained in the mouth by buckles upon the cheek pieces or face straps A nose-band is usual but not essential; a poll strap behind the ears, and a throat strap or 'lash' fastening under the throat Harness bridles differ from riding bridles in being stouter and having blinders or blinkers upon them The word 'bridle' is sometimes used by doctors of animals to indicate the *frænum linguæ*, or governing substance under the tongue, which attaches it to the floor of the mouth In this region is a salivary duct, which is occasionally the seat of trouble through a seed, as an oat corn, getting into it, or calculus forming therein A bridle with a muzzling arrangement over the mouth is variously called a muzzle or a bridle [H L]

Bridle Band.- This name is generally applied to the portion of the bridle which crosses the forehead, and through loops of which on either side the cheek straps pass Saddlers usually call it the forehead strap or faceband

[H L]

Bridle Hand.—The left hand of the horseman is called his bridle hand, and the right one the whip hand When not using both hands for the guidance of his steed he carries the bridle in the left [H L]

Bridle-way. — According to the Encyclopædia of the Laws of England, a bridle-path or horse-way 'is a way along which a man has a right to ride or lead a horse although he owns no estate or interest in the soil Such right may be either public or private And as a rider must occasionally dismount, a horse-way includes a foot-way (Selwyn, N P. 1263)' 'Pack-ways', along which the transport of goods commonly took place in former days by means of horses laden with burdens or 'packs', were ways of this kind They were frequently cobbled, and too narrow to admit of more than one horse passing at a time, and passing-places were provided. A bridle-path proper differs from a 'drift-way', along which there is a right to drive cattle, and though a way may be both a bridle-path and a drift-way, there is no right of driving cattle along a mere bridle-path (see Ballard *v* Dyson, 1808, 1 Taunt 279)

A private right of way may be acquired by grant express or implied, or by prescription by user for twenty years without interruption (Prescription Act, 1832, 2 & 3 Will IV, c 71, s 2). A public right of way is acquired by dedication from the owner of land, which may be implied from user by the public. [A. J. S.]

Brie Cheese.—Among the various kinds of soft cheese made in France there is, quite naturally, a prevalent family likeness. Unlike the predominant type of cheese made in England, or in Switzerland, they are made to be eaten quite early. And though they may differ more or less in size and features, they all belong to one comprehensive genus, one broad and unmistakable type, to wit, soft cheese. The kind known as Brie is generally supposed to be the largest of the French soft cheeses—the largest, that is to say, in diameter if not in depth. This may be true in regard to a portion of the Brie, but not to all of it. Indeed, it may be said that the Brie differs from itself in diameter, rather than from other kinds of cheese in France, for it is made in various sizes.

An expert in French cheese has this to say: 'One of the most important cheeses made in France, the Coulommier, is essentially the same as the Brie, but smaller in size, and whereas the Brie cheese is made of skim, or of half-skim, or of new milk, the Coulommier is always made of full new milk'. There are, consequently, at least three qualities of Brie cheese, and these no doubt appeal in price to at least three classes of customers. The prices at which the different qualities are sold vary from 1s. 6d. per lb. for cheese of the highest quality and condition down to half that figure, or less, for the lowest grade. The larger of the Brie cheeses are the most popular and also the more famous. This, however, is obviously a question of superior quality, indicating a 'full, new-milk origin'.

The dairy apartments in which the cheese is made are intentionally maintained, as nearly as circumstances admit of, at a temperature not exceeding 65° F. Experience extending over a long series of years has established this as a point of first-rate importance, because too high an atmospheric temperature within the dairy expedites too much the subsequent separation of the whey from the curd. The result is a dry cheese, which is obviously the antithesis of a soft one. On the other hand, however, a temperature appreciably below 65° retards the separation, and a cheese too soft is the almost certain consequence.

One dram of rennet, whose strength and uniformity are reliable characteristics, is sufficient to coagulate 15 gal. of milk, whose temperature is about 82° F., in three and a half to four hours. When the correct stage of coagulation has arrived, the curd is not broken or cut, but carefully ladled out into moulds. These moulds, unlike the moulds employed in the making of Camembert cheese, are not perforated around the circumference. The moulds are hoops, circular and flat-bottomed, resting on a straw mat which sufficiently promotes the escape of the whey. Six hours after ladling it into the hoops the embryo cheese should be sufficiently drained to admit of being turned over. After this first turning, the cheese is turned each three hours, and salting is begun in twenty-four hours, the salt being rubbed over the surface of the stiffening cheese, and sprinkled evenly over the top of it. Very fine salt only is considered good enough. When turned again, the bottom—now the top—side is salted, and this should suffice, for too much salt makes a dry cheese and injures the flavour of it.

Each time the cheese is turned it is placed on a dry, clean, fresh-smelling straw mat, of which an ample supply is always provided by careful makers of the cheese. A frequent change of mats is made, a dry one being always substituted in place of the one that has become wet by the escape through it of the whey, because repeated changes of mats in this way promote the development of the particular fungus—or fungi—which bring about the distinctive flavour of the cheese named Brie, as, in fact, is the case with all kinds of soft cheese that are not specially flavoured by some condiment or other.

After four or five days in the hoop the cheese is taken to the ripening room, which should be maintained at a fairly uniform temperature of 62° to 65° F. Here again temperature plays an important part, and requires careful watching and regulation. For a temperature too high in the room will ripen the cheese too quickly, and a temperature too cold will ripen the cheese too slowly, in which case the highest perfection of ripe cheese cannot be expected.

Once in the ripening room, the cheese is turned over each alternate day, and in a while each third day. At the end of half a week or so a white fungoid growth manifests itself on the skin, or rind, of the cheese, and becomes somewhat blue in a few days time subsequently. The blue becomes a pale yellow later on, and this in turn becomes a grey, at which stage red spots make their appearance. The cheese is then about three weeks old. But if the red spots do not then appear, they are commonly induced to develop themselves by what may be called inoculation. At about six weeks old the cheese has a dark-grey coating of fungus, some of which becomes almost black. This indicates the ripeness and plenary perfection of the cheese, which is then marketed whilst the bloom is still upon it. [J. P. S.]

Brining. See BACON-CURING and BUTTER-MAKING.

Brisket.—The lower part of a horse's chest, more particularly that covering the breast bone (sternum), is called the brisket. Brisket, as applied by butchers, also means the breast portion of an animal, but has a rather wider significance than that intended by the horseman. [H. L.]

Bristles.—Coarse, stiff hairs are called bristles, whether in swine, in which they are most marked, or in other animals. The long, coarse hairs which appear in the latter part of the winter about the face of horses, more especially the lower half of it, are called bristles; and the coarser hairs along the spine of dogs, which are erected when angry, also pass by this name. Structurally they do not differ from other hairs save in their size. [H. L.]

British Columbia. See CANADA.

British Goat Society.—This Society was formed at the third London Dairy Show in

October, 1879, at the instigation of Mr. Holmes Pegler, who was at the time hon. secretary of the British Dairy Farmers' Association, to which the British Goat Society was in its earlier years affiliated. The objects of the Society are: (1) to circulate knowledge and general information upon goats, with a view to counteract the prejudice and ignorance which prevail in a great degree concerning these animals; (2) to extend and encourage the keeping of goats, particularly by cottagers, so as to increase the supply and consumption of milk in rural districts where this article is frequently unobtainable; (3) to improve the various breeds of goats, and especially to develop those qualities which are generally recognized and valued in milch stock. The annual subscription is 10s., except to *bona-fide* cottagers, to whom it is *5s.* The payment of £10 in a single sum constitutes a life member. The Society publishes triennially a Herd Book, included with which is a prize record, or list of goats having won prizes at shows recognized by the Society. Goats that are bred from animals entered in this prize record, and which have themselves won prizes, are eligible for entry in the Herd Book. Vol. I and Parts 1 and 2 of Vol. II of this publication have been issued. In addition to the Herd Book this Society publishes annually a Stud Goat Register, being a list of male goats specially selected to improve the breed as milkers; also the British Goat Society Monthly Circular, containing notices of the publication of articles, reports of shows, &c., together with private advertisements of goats for sale by its members. Pamphlets are also distributed entitled 'The Advantages of Goat keeping', 'Goats for the Supply of Milk to Cottagers', 'A Goat Dairy', 'Goats' Milk *versus* Cows' Milk in Relation to Tuberculosis', &c.

The prestige and progress of the British Goat Society have been due in no small degree to the support and influence of the late Baroness Burdett Coutts, who became patroness of the institution at its formation, and was its president only a year or two before her death at the close of 1906. The Baroness not only lent her name to the Society, but took an active part as a breeder and exhibitor of goats, winning a great number of prizes with her Holly Lodge herd. This herd was sold by auction in May, 1907, and realized extraordinarily high prices.

Goat shows are held annually under the auspices of the British Goat Society at the meetings of other societies, such as the Essex, the Tunbridge Wells, and at the Dairy Show, London. [H. S. H. P.]

Brittany Cattle, a breed of cattle supposed to be descended from importations of Irish cattle. It includes two varieties, the small and the large Brittany.

The *small variety* is found principally around the district of Morbihan, and is very well adapted for the poorer class of pastures which characterize the inland plains of Brittany. Animals of this breed are very small in size, smaller even than the Kerry, but very hardy in constitution and graceful in movement. The head is small and fine; the horns fine at the base and tapering to a point; the neck is relatively long. The head is borne erect. The chest is moderately deep, but the shoulders are somewhat defective and too much wedged. The back is straight, the spine prominent, the quarters rather light, and the tail high set on. The legs are short, but fine-boned, making the body appear somewhat long. The udder is large and rounded; the teats are short and close set, yet large in comparison with the size of the body. Black and white is the predominating colour, the muzzle and the eyelids generally being black. The hoofs and horns are very yellow in colour. Cows of this breed yield a comparatively large supply of milk, which is rich in butter fat.

The *large variety* of Brittany cattle is of greater size and stronger constitution than the smaller variety. It is more symmetrical in outline, and has a better body. Black and white as before is the prominent colour. In other respects it resembles the smaller breed. Attempts have been made to improve this breed by crossing with the Ayrshire and Shorthorn, but now the chief aim is to preserve the purity of the breed.

Brittany Horses.—The horses of Brittany include three distinct varieties. One known as *Le Cheval des Landes de Bretagne* is, as its name implies, found mostly on the inland plains of Brittany, and is of Asiatic origin. It is of small size and light build, and often coarse and unsymmetrical in shape, but nevertheless very hardy. It varies in height, but rarely exceeds 14.2 hands. The other two varieties are of Irish descent, and occupy the plains around the coast. These horses are of a hardy character, and strong and coarse-looking. The type which is found in the south-west corner of Brest (*Cheval de Conquet*) is short and stubby in appearance, well coated with hair on the limbs. Bay or black is the usual colour. Horses of this breed live to a good old age, and are extensively employed for draught purposes. They stand from 14.2 to 15.2 hands.

The other type (*Le Cheval de Léon*) is largely bred around the districts of Côtes du Nord and Saint-Pol-de-Léon. It is slightly larger than the preceding, standing from 15.2 to 16.2 hands, with strong, thick neck and shoulders, but it has the same compactly built appearance, though the mane is coarser and the haunches larger. The joints are well formed, and the pasterns covered with long hair. Grey is the predominating colour. Horses of the Léon variety are largely used for light draught purposes, and they make good farmers' 'nags' for general purposes.

Briza.—A genus of grasses belonging to the division with many-flowered spikelets on long stalks. It is known by its heart-shaped spikelets, by its broad three-ribbed glumes, and its boat-shaped, blunt, broad, awnless lower pales.

Briza media (Quaking Grass, Silver Shekels)—This is a perennial plant with tufted fibrous roots. The stem never exceeds 18 in. in height, and is usually shorter; it bears at the base a number of dark-green leaves. Quaking Grass flowers in the end of June, and is ripe by the middle of July. Its agricultural value appears to be very small. Sinclair says that horses,

BROADCAST MANURE DISTRIBUTORS AND BROADCAST SOWER

WALLACE'S VICTOR MANURE DISTRIBUTOR.—The machine is set into action by means of the small lever on the hub of the right travelling wheel (see Plate). In work the machine is fitted with detachable wind boards, and if it is desired to deposit the manure in drills for roots or potatoes, drilling spouts can be attached to these. The cleaning is simple, as by pulling over the lever at the centre of the prongs, the drum forming the bottom of the hopper drops downwards, and the prongs are freely exposed, as shown in Plate. Wide machines can be mounted on endwise transport wheels to pass through narrow gateways.

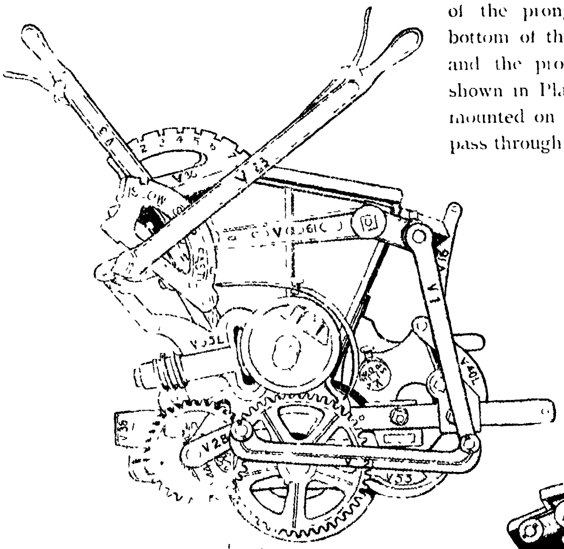


Fig. 1

Fig. 1 shows the gearing on the left side of the hopper, and Fig. 2 that on the right. By moving the lever V 23 (Fig. 1) to 'Fast' on the quadrant the speed is increased by three times, as the fine worm is lifted out of gear, and the coarse or fast gear on the other side of the box (Fig. 2) is put into action, and the rate of sowing is increased threefold. Thus when the lever V 3 is set in notch 3 of the regulator with the slow gear 3 cwt. per acre are sown, but by changing to the fast gear 9 cwt. are sown. Other quantities are sown accordingly as the regulator lever is set, but the numbers on the quadrant V36 indicate approximately the cwt. per acre when the slow speed is in gear, and three times that on the fast gear. SP1 is the tilting lever to regulate the pitch of the box when working on inclines.

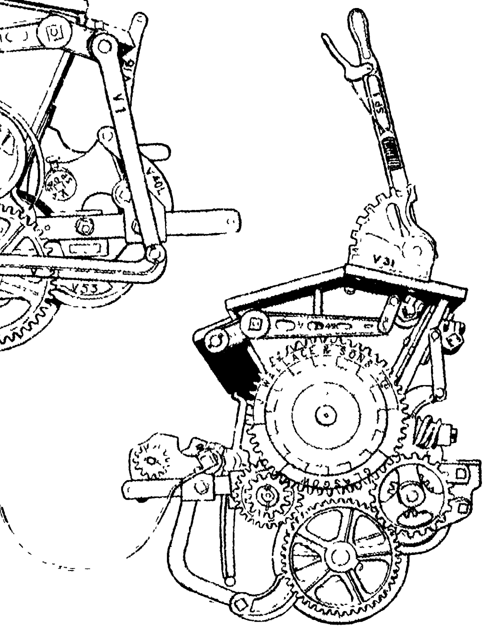
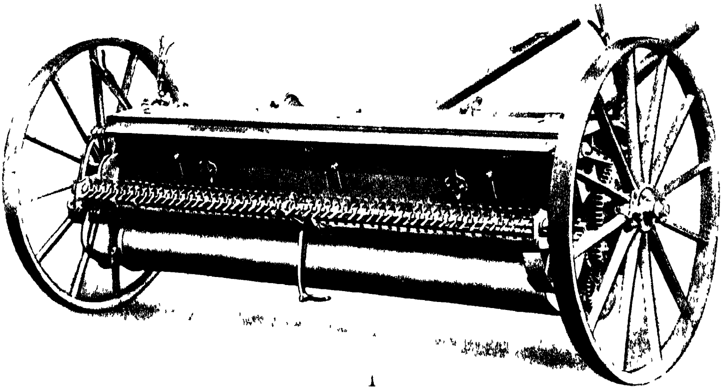


Fig. 2

COUTTAS' MANURE DISTRIBUTOR.—The view in the Plate shows the movable hopper (lowered) and rotary rake.

WOODNOUGH'S BROADCAST SOWER.—For description and diagram of Change Gear see page 240.

BROADCAST MANURE DISTRIBUTORS AND BROADCAST SOWER



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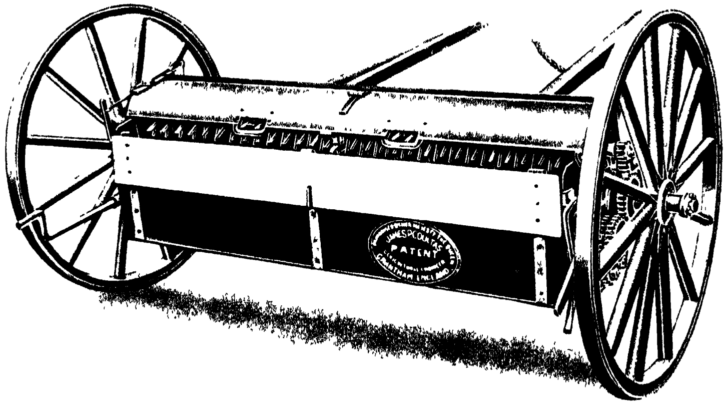

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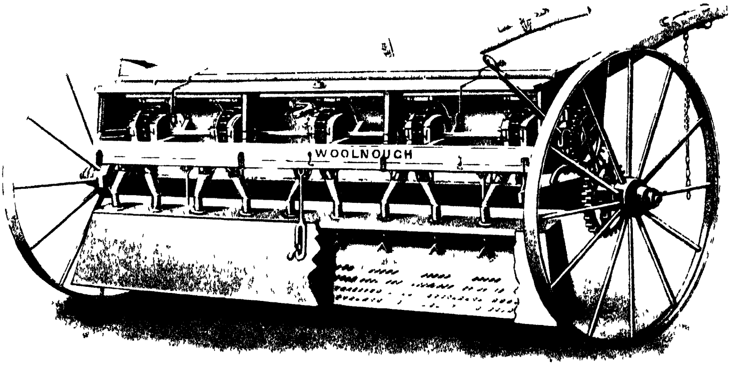
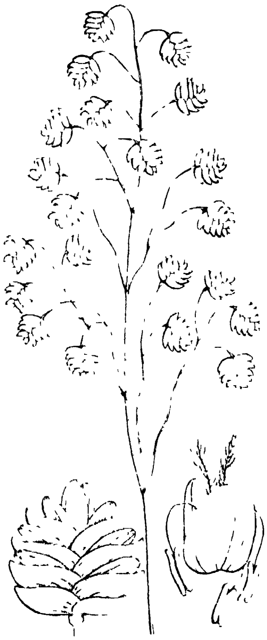


1 Wallace's Victor Manure Distributor 2 Coultas' Manure Distributor
3 Woolnough's Broadcast Sower

cows, and sheep will eat it, and that it is well suited to poor soils, whether sandy or heavy The ears of this grass are very ornamental, and country people often gather bunches of 'Silver Shekels', as they call them, to be used by way of ornament in their homes. This and other species are grown in gardens as ornamental plants [I L]



Quaking Grass (*Briza media*)

[A. N. M'A.]

Broadcast Manure Distributors. — When it is remembered that the substances which are used as artificial manures—as concentrated fertilizers are commonly called in Britain—vary very much in the size of the particles, specific gravity, freedom of running, moisture generally present, and other features, it will be seen that a machine which will separate a given quantity and distribute it evenly over a given surface must possess many attributes; also that it will differ from a sowing-machine since the 'feeds', or method of abstracting required quantities of freely running kernels of grain, are not necessarily so well suited to manure distribution. A great difficulty to overcome is the tendency of heavy, finely divided, somewhat moist substances to become compacted in the hoppers, and to form a bridge about the stirrers, so that, although they revolve, no manure is forced out. Machines constructed with hoppers which become narrow at the bottom are particularly liable to this fault of 'bridging'. Some manures consist of particles of various sizes, and these are not well suited to be sown by machines which distribute by horizontal force or throw, as the larger particles fly much farther than the smaller; there is the same objection to those which distribute by wind force. Moreover, these types of machine are generally dependent upon the pace of the horse as to the distance they throw, and as horses are irregular in their pace, and there are the ordinary stoppings and startings, such accuracy as is desirable is not attained We maintain this in spite of the recent awards by the R.A.S.E. Cup feeds, where a series of cups are placed about the periphery of disks carried on a spindle running from end to end of the box, work irregularly when the manure is moist or adhesive, as the cups, no matter what the exact form they take, are liable to become more or less clogged, so that irregular quantities are expelled Chain feeds and force feeds are subject to similar blockings Altogether, unless the manure runs very freely, all the feeds mentioned are faulty There are two types which more nearly attain perfection, one made by Wallace of Glasgow, and the other by Coultas of Stamford In the former the bottom of the hopper is formed by a smooth revolving drum of large diameter provided with flanges at each end The manure is compelled to fall upon this roller by a vibrating side This roller conveys the contents of the hopper to a small semicircular receiver above, and in which rotates a spreader, consisting of a series of quickly revolving spikes or prongs The feed is easily regulated, and evenness of distribution secured in quantities from ¼ cwt to 1 ton per acre

In Coultas's machine the hopper, instead of being fixed, is made to raise and lower The bottom and front side rise, but the back side is fixed, and the moving portion rises slowly, according as it is regulated, the manure is brought up to a rotary rake studded with metal teeth, and as fast as it reaches the rake it is tipped over the edge The gearing to effect the change of speed, and the raising and lowering of the hopper, is very simple to operate When the hopper is emptied it can be speedily lowered for refilling by means of a hand-worked worm gearing

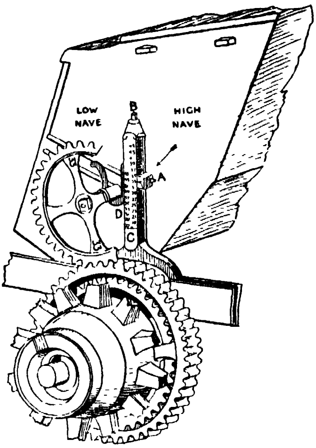
It is not desired to give an impression that other machines are useless, they distribute more evenly than can be done by hand, but the necessity for absolutely perfect distribution cannot be too strongly urged, the manure must go to the plants, as the plants can go very little towards the manure Uneven distribution implies that some portions of the crop receive an undue share, while others have a deficiency. When a farmer allows a certain quantity of manure per acre, he does it with the intention that it shall be bestowed equally It is particularly necessary that quickly acting, highly concentrated manures like nitrate of soda be evenly sown, or the quality of corn throughout a field may vary considerably. Too much in spots will tend to produce mildew in wheat, or in barley coarseness and variation in quality.

[W. J. M.]

Broadcast Sowers.—In Britain, especially in the southern portion, the sower comparatively rarely goes forth to sow with his hands; mechanical distribution is mainly relied upon. Corn and seed sowers were in common use before manure sowers were required, and in many instances manure broadcasting devices were adapted from the corn sower. Most of the methods adapted to broadcast sowing are applicable to drill sowing, but not all of them, though as a rule those not applicable to the drill do not rank high in popular opinion as broadcasters. Efficient distribution is secured by several methods. The standard 'feeds', or methods of delivering constant quantities of grain from the bulk to the ground, are as follows: cup, tooth, and brush pinion, disk chain, force feed, suitable for drills and broadcasters; and wind blast and circular throw, suitable only for broadcasters. The cup feed requires an upper main hopper, in which the seed is placed, and a lower hopper or box, into which the seed passes through controlling ports. The spindle carries a number of disks, about the periphery of which are placed a series of spoons or cups which scoop up the seed as the spindle revolves, and pass it into a shoot leading to the ground. The chief failing of this system is that on bumpy ground an undue quantity of seed is shaken from the cups, so that they arrive at the distributing point with a deficiency, as rough ground generally requires more seed than the smoother parts of the field, the weakness is intensified.

Woolnough's broadcast sowing machine, illustrated in Plate, fig 3, is a good type of this class. The main spindle is seen running through the feed box, carrying cups to raise the corn to tunnels, and delivering through short spouts to studded spreading board to ensure even distribution. The pitch of the feed box is regulated by a worm and quadrant so as to adapt the position to inclines. The spindle is driven from a nave gearing on the travelling wheel through an intermediary cogwheel, which acts as the 'change' wheel, change wheels of different sizes regulate the speed of the spindle and the rate of seeding. The smaller cogwheel, marked 33 in annexed diagram, is carried on a bearing D from the vertical standard C, marked with indicator numbers. The 'change' wheel engages with the nave wheel in proper position when the pointer A is opposite to the number on the wheel (which denotes the number of cogs). The raising and lowering of the indicator are effected by turning the screw B. It is obvious, as the nave wheel is in a fixed position, that provision has to be made to adapt wheels of varying size to it.

Tooth and brush pinion feeds have a pig-trough-shaped hopper, through which runs from end to end a spindle carrying occasional disk-shaped brushes which force the seed through holes pierced in the rear side of the hopper. They are better suited for small seeds, such as clover, grass, mustard, and turnip, than for the heavier seeds, as on hillsides the heavier seed is liable to fall away from the brushes, and an irregular distribution results. The brushes also do not always wear equally. Disk feed is very similar to brush feed, but in place of the brushes there are metal disks with wavy edges, which alternately open and close ports in the seed box, bringing forward seed and forcing it through. The failings on hillsides are much similar to those of brush feeds. Chain feed, or the use of an endless chain running crosswise through the hopper, and thus carrying the seed to the discharging funnel, works well on rough and hillside land, except that it is not quite reliable as to regularity. Force feed, popular in most countries, and fast gaining popularity in Britain, is the most reliable. The bottom of each seed hopper is closed by a small spirally grooved roller, which, revolving as the machine advances, supplies seed in a regular stream to the funnel. A follower or blank portion of roll closes the aperture in the hopper. Rotary disks, placed horizontally below the hopper, on to which grain is made to fall, and thus receive a semicircular throw, are but little used; so also is the wind-blast feed, where the grain is made to fall on to a fan-shaped plate with guides, receiving a strong blast from a rapidly driven fan. Whatever merit these two might possess, it is nullified by the irregular pace of horses drawing the machine. All the methods described have the virtue that they are easy to actuate; consequently as there is no friction from coulters, as in the case of drills, they are made capable of sowing a much greater width. The hand seed-barrow with brush pinions is made up to 15 ft or more, and can be conveniently propelled by a man. [W. J. M.]



Change Gear for Woolnough's Broadcast Sower

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